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INSTRUCTION BOOK

For

MODULATOR 50H

AND

MODULATOR 50H1

Manufactured By
WILCOX ELECTRIC COMPANY, INC.
Kansas City 6, Mo., U.S.A.

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Return to STM

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(Rear of Book following page 88)

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WARNING

HIGH VOLTAGE

Is used in the operation of this equipment.

DEATH ON CONTACT

may result if operating personnel fail to observe all safety precautions.

Voltages as high as 4,500 volts are used in the operation of this equipment. These voltages are dangerous to life.

Do not change tubes or make adjustments inside this set with the high-voltage supply on.

All hinged panels which can be opened by handles to give access to the inside of the equipment are provided with interlocks to shut off the equipment when the panels are opened. Panels screwed or bolted on do not have these interlocks. A few service checks must be made inside the set with the high voltage on. When making these checks, always have present another person capable of rendering first aid. Keep one hand in your pocket while making high-voltage measurements. This precaution will prevent your touching the electrical circuit with more than one part of the body at one time.

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First Aid for Electric Shock

RESCUE.

In case of electric shock, shut off the high voltage at once and ground the circuits. If the high voltage cannot be turned off without delay, free the victim from contact with the live conductor as promptly as possible. Avoid direct contact with either the live conductor or the victim's body. Use a dry board, dry clothing, or other nonconductor to free the victim. An ax may be used to cut the high-voltage wire. Use extreme caution to avoid the resulting electric flash.

SYMPTOMS.

a. Breathing stops abruptly in electric shock if the current passes through the breathing center at the base of the brain. If the shock has not been too severe, the breath center recovers after a while and normal breathing is resumed, provided that a sufficient supply of air has been furnished meanwhile by artificial respiration.

b. The victim is usually very white or blue. The pulse is very weak or entirely absent and unconsciousness is complete. Burns are usually present. The victim's body may become rigid or stiff in a very few minutes. This condition is due to the action of electricity and is not to be considered rigor mortis. Artificial respiration must still be given, as several such cases are reported to have recovered. The ordinary and general tests for death should never be accepted.

TREATMENT.

a. Start artificial respiration immediately. At the same time send for a medical officer, if assistance is available. Do not leave the victim unattended. Perform artificial respiration at the scene of the accident, unless the victim's or operator's life is endangered from such action. *In this case only*, remove the victim to another location, but no farther than is necessary for safety. If the new location is more than a few feet away, artificial respiration should be given while the victim is being moved. If the method of transportation prohibits the use of the Shaeffer prone pressure method, other methods of resuscitation may be used. Pressure may be exerted on the front of the victim's diaphragm, or the direct mouth-to-mouth method may be used. Artificial respiration, once started, must be continued, without loss of rhythm.

b. Lay the victim in a prone position, one arm extended directly overhead, and the other arm bent at the elbow so that the back of the hand supports the head. The face should be turned away from the bent elbow so that the nose and mouth are free for breathing.

c. Open the victim's mouth and remove any foreign bodies, such as false teeth, chewing gum, or tobacco. The mouth should remain open, with the tongue extended. Do not permit the victim to draw his tongue back into his mouth or throat.

d. If an assistant is available during resuscitation, he should loosen any tight clothing to permit free circulation of blood and to prevent restriction of breathing. He should see that the victim is kept warm, by applying blankets or other covering, or by applying hot rocks or bricks wrapped in cloth or paper to prevent injury to the victim. The assistant should also be ever watchful to see that the victim does not swallow his tongue. He should continually wipe from the victim's mouth any frothy mucus or saliva that may collect and interfere with respiration.

e. The resuscitating operator should straddle the victim's thighs, or one leg, in such manner that:

(*1*) the operator's arms and thighs will be vertical while applying pressure on the small of the victim's back;

(*2*) the operator's fingers are in a natural position on the victim's back with the little finger lying on the last rib;

(*3*) the heels of the hands rest on either side of the spine as far apart as convenient without allowing the hands to slip off the victim;

(*4*) the operator's elbows are straight and locked.

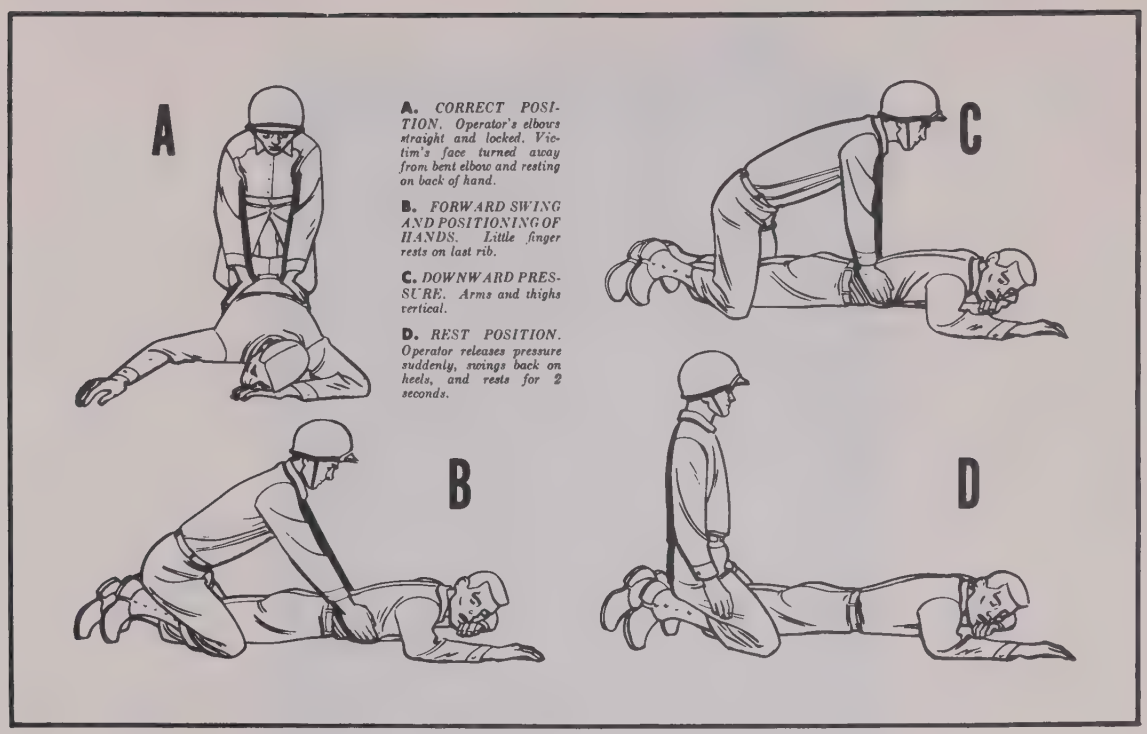
f. The resuscitation procedure is as follows:

(*1*) Exert downward pressure, not exceeding 60 pounds, for 1 second.

(*2*) Swing back, suddenly releasing pressure, and sit on the heels.

(*3*) After 2 seconds rest, swing forward again, positioning the hands exactly as before, and apply pressure for another second.

g. The forward swing, positioning of the hands, and the downward pressure should be accomplished in one continuous motion, which requires 1 second. The release and backward swing require 1 second. The addition of the 2-second rest makes a total of 4


A
B
C
D
A. CORRECT POSITION. Operator's elbows straight and locked. Victim's face turned away from bent elbow and resting on back of hand.
B. FORWARD SWING AND POSITIONING OF HANDS. Little finger rests on last rib.
C. DOWNWARD PRESSURE. Arms and thighs vertical.
D. REST POSITION. Operator releases pressure suddenly, swings back on heels, and rests for 2 seconds.

seconds for a complete cycle. Until the operator is thoroughly familiar with the correct cadence of the cycle, he should count the seconds aloud, speaking distinctly and counting evenly in thousands. Example: one thousand and one, one thousand and two, etc.

h. Artificial respiration should be continued until the victim regains normal breathing or is pronounced dead by a medical officer. Since it may be necessary to continue resuscitation for several hours, relief operators should be used if available.

RELIEVING OPERATOR.

The relief operator kneels beside the operator and follows him through several complete cycles. When the relief operator is sure he has the correct rhythm, he places his hands on the operator's hands without applying pressure. This indicates that he is ready to take over. On the backward swing, the operator moves and the relief operator takes his position. The relieved operator follows through several complete cycles to be sure that the new operator has the correct rhythm. He remains alert to take over instantly if the new operator falters or hesitates on the cycle.

STIMULANTS.

a. If an inhalant stimulant is used, such as aromatic spirits of ammonia, the individual administering the stimulant should first test it himself to see how close he can hold the inhalant to his own nostril for comfortable breathing. Be sure that the inhalant is not held any closer to the victim's nostrils, and then for only 1 or 2 seconds every minute.

b. After the victim has regained consciousness, he may be given hot coffee, hot tea, or a glass of water containing ½ teaspoon of aromatic spirits of ammonia. *Do not give any liquids to an unconscious victim.*

CAUTIONS.

a. After the victim revives, keep him LYING QUIETLY. Any injury a person may have received may cause a condition of shock. Shock is present if the victim is pale and has a cold sweat, his pulse is weak and rapid, and his breathing is short and gasping.

b. Keep the victim lying flat on his back, with his head lower than the rest of his body and his hips elevated. Be sure that there is no tight clothing to restrict the free circulation of blood or hinder natural breathing. Keep him warm and quiet.

c. A resuscitated victim must be watched carefully as he may suddenly stop breathing. *Never leave a resuscitated person alone until it is CERTAIN that he is fully conscious and breathing normally.*

Figure 1. Modulator Type 50H

CHAPTER 1

INTRODUCTION

SECTION I. GENERAL

1. Scope

This instruction book contains instructions for the installation, operation, maintenance, and repair of Modulator Type 50H (fig. 1). In addition to these instructions, there are two appendixes covering an identification table of parts, and a wire list for the interconnection diagram.

2. Forms and Records (To be used by personnel of U. S. Armed Forces. Not applicable commercially).

The following standard forms will be used for reporting unsatisfactory conditions of materiel and equipment, or improper preservation, packaging, packing, marking, loading, stowage, or handling thereof.

a. DD Form 6, Report of Damaged or Improper Shipment (Reports Control Symbols CS GLD-66 (Army), S and A-70-6 (Navy), and AF-MC-U2 (Air Force)), will be filled out and forwarded as prescribed in SR 745-45-5 (Army), NAV DEPT SERIAL 85P00 (Navy), and AFR 71-4 (Air Force).

b. DA AGO Form 468, Unsatisfactory Equipment Report (Reports Control Symbol CS GLD-247), will be filled out and forwarded to the Office of the Chief Signal Officer, as prescribed in SR 700-45-5.

c. AF Form 54, Unsatisfactory Report will be filled out and forwarded to Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio, as prescribed in SR 700-45-5 and AFR 65-26.

d. Use other forms and records as authorized.

SECTION II. DESCRIPTION AND DATA

3. Purpose and Use

a. Modulator Type 50H is a unit consisting of a speech amplifier and associated modulator components for amplitude modulating the plate voltage supplied to the final amplifier stage of a transmitter; a dialing and auxiliary relay unit for local and remote control of the modulator and its related transmitter and rectifier equipment; and a control panel for local control (fig. 2).

b. The speech amplifier and associated modulator components provide 1,600 watts of audio power, flat within 1 db (decibel) from 400 to 3,000 cps (cycles per second). It operates with an audio signal input from plus 3 db to minus 20 db (0 db = 6 mw (milliwatts)).

c. The dialing and auxiliary relay unit provides a switching system for the interconnection of one of two rectifiers, one of a group of transmitters which may consist of as many as ten transmitters, and the modulator.

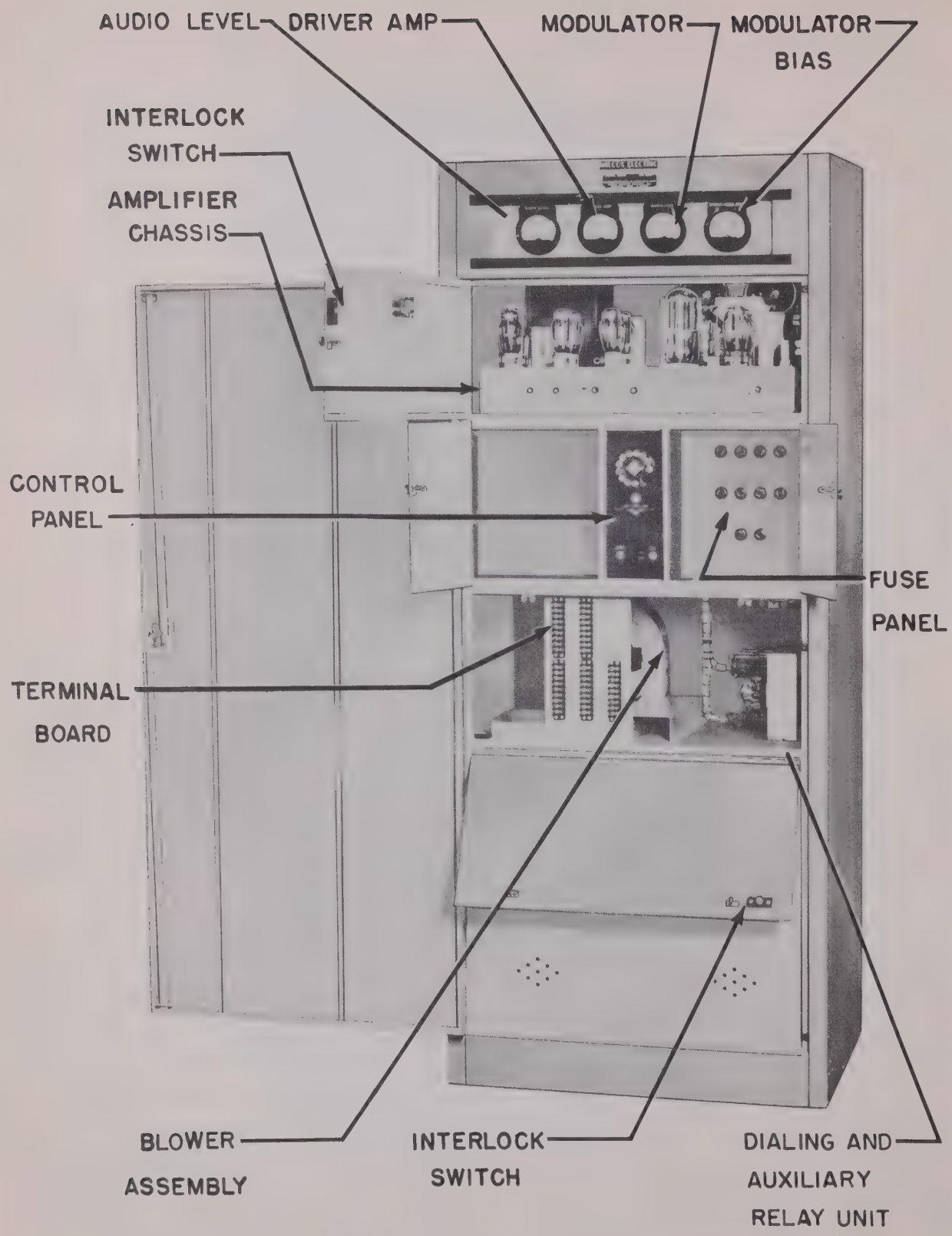


Figure 2. Modulator Type 50H

d. The control panel, with its related dial, provides local control of the dialing and auxiliary relay unit.

e. The modulator is designed to operate as a part of a large, fixed field installation providing ground-to-air and point-to-point signal communications.

4. Application of Equipment

a. Modulator Type 50H is used as a part of a system involving one or two modulator equipments, an equal or greater number of Rectifier Power Units (Wilcox "36" series), and one to ten Radio Transmitters (Wilcox "96" series). In large installations requiring more than two voice-modulated channels, as many as four modulators may be used in a single installation.

b. A simplified block diagram of a typical installation is shown in figure 3. This is typical of a large installation since one modulator, two rectifier power units, and six transmitters are used. Also shown are a terminal box at the control location and a bank of remote control units. A station may comprise any lesser number of transmitters and remote control facilities. Only one modulator may be used. If more than one modulator is used, at least an equal number of rectifier power units must be in operation in order to meet the power requirements of the equipment.

c. As many as ten transmitter channels and the available modulator channels may be selected, either locally, using the dial selector which is part of the modulator assembly, or remotely, using a similar dial selector. The channel and operation selection is accomplished by a dialing and auxiliary relay unit which is part of the modulator assembly Selection is done by a stepping relay which is actuated at the completion of a relay sequence. Vacu-

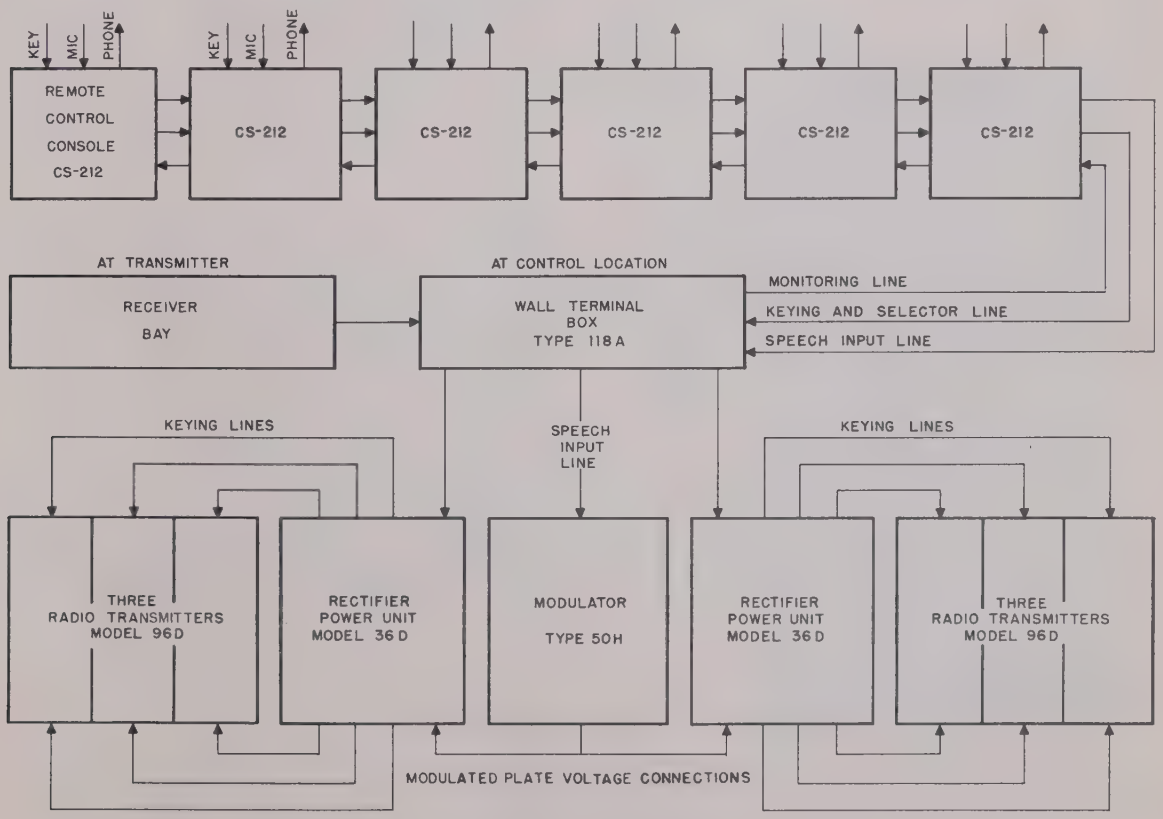


Figure 3. Block diagram of complete installation

um-type h-v (high-voltage) switches in the rectifier power unit, controlled by the stepping relay, control the hv supplied to the modulator and transmitter units.

5. Technical Characteristics

Audio input:

Impedance.....50, 125, 500 ohms.
Level.....-20 to +3 db (.006 watt reference level).
Audio output power.....1,600 watts, nominal.
Audio frequency response.....400 to 3,000 cps ±1 db. Input terminal 500-ohm impedance, output terminal 4,500-ohm impedance.

Power input:

Modulator hv.....4,200 volts dc (direct current) ± 5%, .7 ampere.
Relay system.....12 to 15 volts dc, 2 amperes.

A-c power.....220 volts ac (alternating current) single phase, 60 cps, 4 ampere.

Number of tubes.....13.

Weight.....775 pounds.

6. Packaging Data

a. When packaged for export shipment, the components of Modulator Type 50H are placed in moisture-vaporproof containers and are packed in three wooden export crates. A cutaway view of a typical component packed for export is shown in figure 10. The size, weight, and volume of each crate are indicated in the following chart:

Note. Items may be packaged in a manner different from that shown, depending on supply channel.

Number of containers	Height (in.)	Width (in.)	Depth (in.)	Volume (cu ft)	Weight (lb)
1/3	85	42	33	75	985
2/3	38-3/4	36	20	10	315
3/3	30	24	16	7.5	275
Total weight (lb)					1,575

b. The contents of each case are given in the table of components (par. 7). See the packing list attached to each case for exact contents.

7. Table of Components

Component	Required No.	Height (in.)	Depth (in.)	Width (in.)	Volume (cu ft)	Weight (lb)
Package 1/3:						
Modulator Type 50H						
Cabinet assembly	1	72	26-3/8	29-1/2	30.1	475
Set of operating and spare fuses	1	4-1/2	3	6	.05	1

7. Table of Components (contd.)

Component	Required No.	Height (in.)	Depth (in.)	Width (in.)	Volume (cu ft)	Weight (lb)
Set of operating and spare tubes	1 1	18-1/2 20	12-1/4 10	9 10	1.2 1.2	8.4 8.4
Set of vacuum switches	1	5	5	2	.3	1
Instruction book	1	1	10	13	.1	1
Package 2/3:						
Amplifier chassis	1	10-3/4	22-1/4	24-1/4	3.4	115
Package 3/3:						
Modulation transformer	1	13-1/2	8-1/2	12	.8	118
Filter reactor	1	8-1/2	6-1/4	8-1/2	.3	40
Filter capacitor	1	9	4-1/4	13-1/2	.3	26

Note. This list is for general information only. See appropriate supply publications for information pertaining to the requisition of spare parts.

8. Description of Modulator Type 50H

a. General Modulator Type 50H is a unit consisting of the following: assemblies: amplifier chassis, dialing and auxiliary relay unit, control panel, four meters, blower, fuses, terminal board, filter reactor, filter capacitor, and modulation transformer. All the equipment listed above is mounted in a built-up steel cabinet. Figure 4 is a front view of the modulator with the control panel exposed. Figure 5 is a rear view of the modulator with the rear panel mounted; figure 6 is a rear view of the modulator with the panel removed.

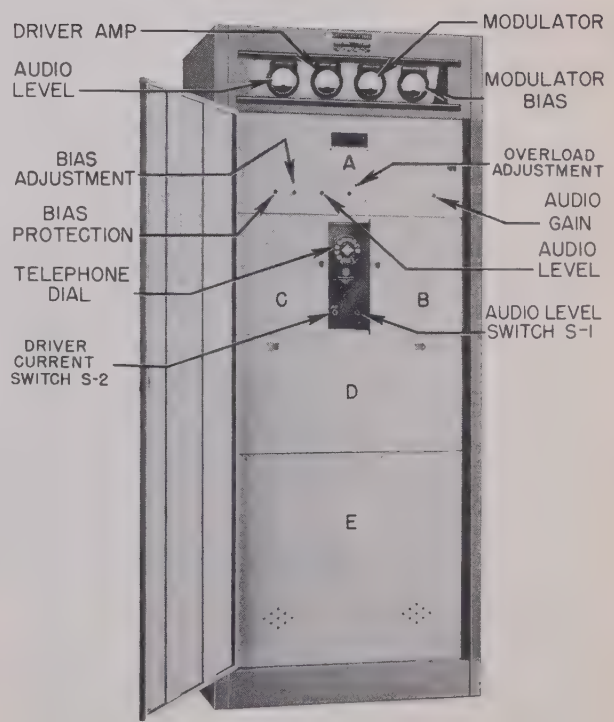


Figure 4. Modulator Type 50H, front view with door opened

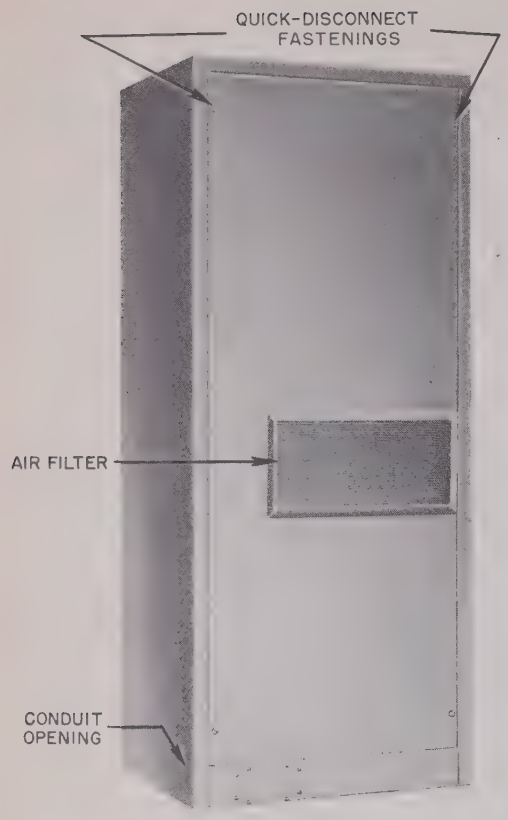


Figure 5. Modulator Type 50H, rear view

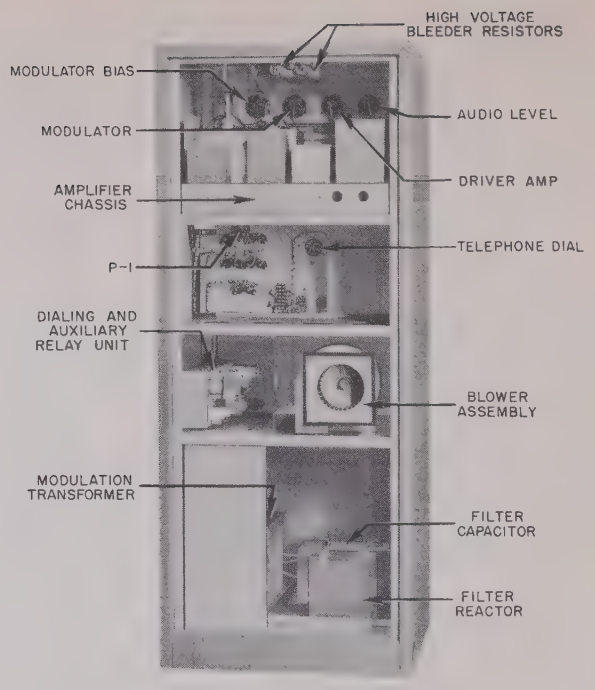


Figure 6. Modulator Type 50H, rear view with panel removed

b. Cabinet. The cabinet which houses all the components of Modulator Type 50H is built of steel. Doors at the front and rear of the cabinet provide easy access to the interior, permitting servicing of the equipment. The components are mounted on four shelves which are built into the cabinet. At the top front of the cabinet are four meters which provide visual indication of the equipment operation. These meters, from left to right, are as follows:

AUDIO LEVEL, DRIVER AMP, MODULATOR, MODULATOR BIAS. A door covers the front of the cabinet from below the meters to just above the floor. When this door is open it exposes four doors, a large safety panel, and the control panel. Directly below the meters is a door which incloses the amplifier chassis. This door has an interlock switch and a window which provides a view of the equipment during operation. Across the bottom of the door are five holes which provide access to screwdriver adjustments on the amplifier chassis. On the second shelf are two doors; the one on the left incloses a panel which is not used, the one on the right incloses the fuse panel. Between the first and second shelves in the center is a control panel which has a dialing unit and two switches (DRIVER CURRENT and AUDIO LEVEL) mounted on it. The equipment mounted in the compartment between the second and third shelves is exposed by opening the large door which is swung on a piano hinge. This door is equipped with an interlock. Mounted within the compartment is the terminal board, blower motor assembly, and the dialing and auxiliary relay unit assembly. The equipment mounted at the bottom of the cabinet is exposed by removing the safety panel at the front of the cabinet. This panel is removed by removing the four screws and lifting the panel up and out of the unit. Inside the unit are the modulation transform-

er, filter reactor, and filter capacitor. Access to the rear of the cabinet is provided by removing the large rear panel. This panel is held in place by six quick-release fasteners, and is equipped with an interlock. At the bottom of the cabinet, access holes are provided for the interconnection wiring which runs between the modulator and its related transmitter, rectifiers, and remote control units.

c. Amplifier Chassis (fig. 7). The amplifier chassis is mounted on the top shelf of the cabinet. The function of this unit is to amplify the audio signal generated at the remote control console and to use this amplified signal, with related modulation transformer, to modulate the plate voltage for the final r-f amplifier stage in a transmitter. Thirteen tubes, seven capacitors, six transformers and one filter choke are mounted on the top of the amplifier chassis. Five screwdriver adjustment controls are mounted on the front panel and are so located that they are accessible from the front of the cabinet when the compartment door is

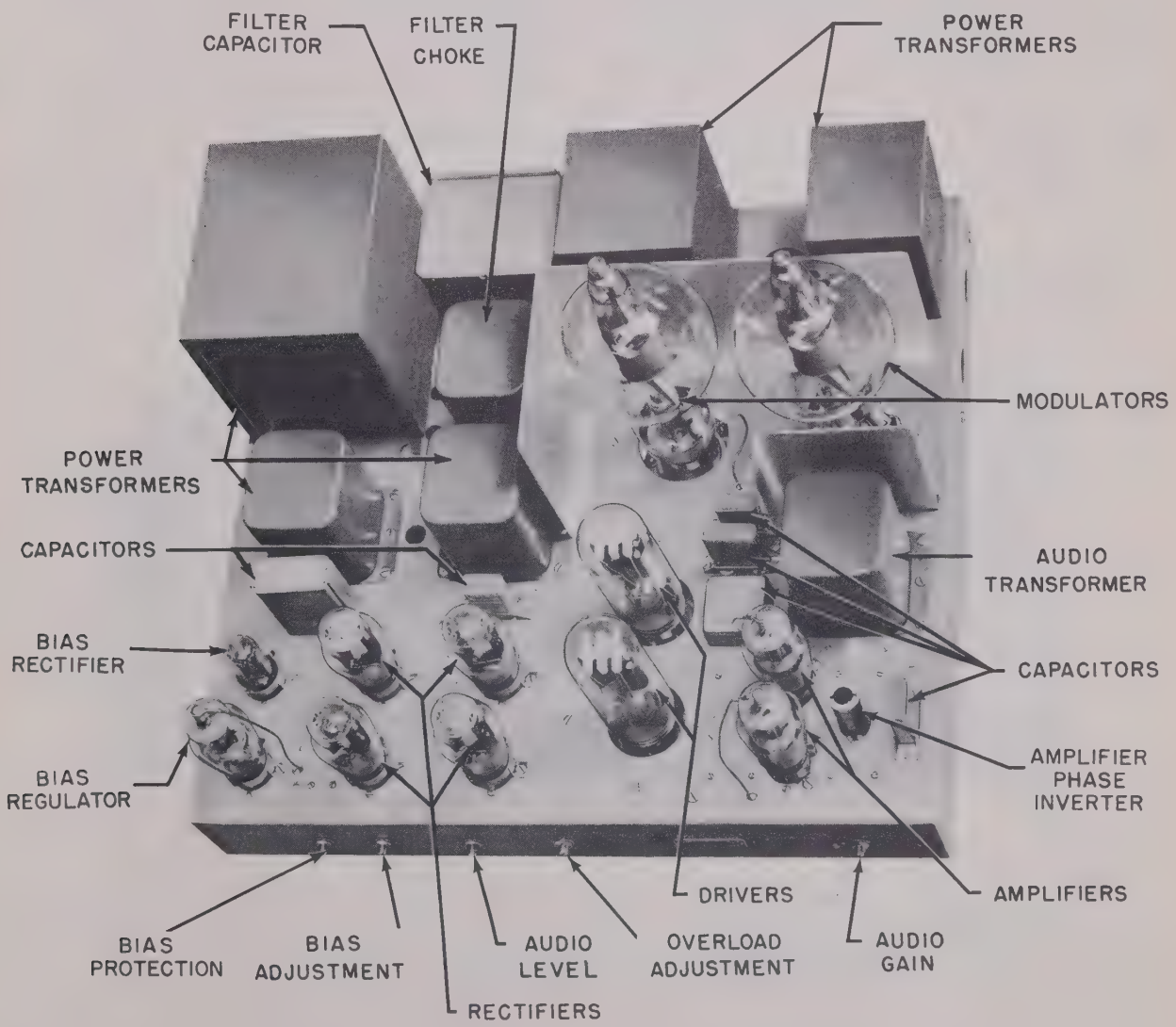


Figure 7. Modulator Type 50H, amplifier chassis

closed (fig. 4). All connections to the amplifier chassis with the exception of two h-v connections are made by a plug which is inserted into the mating receptacle on the under side of the chassis. The two h-v connections are made by two leads which are connected to the plate caps of the modulator tubes. All the other circuit components and wiring are mounted on the under side of the chassis.

d. Dialing and Auxiliary Relay Unit (fig. 8). The dialing and auxiliary relay unit is mounted at the right side of the cabinet between the second and third shelves. Mounted on this chassis are nine relays, a stepping relay, a metallic rectifier, an audio transformer, a capacitor, and a toggle switch. The relays are functionally separated into two groups. One group, which consists of four relays and the stepping relay, causes the connections of the modulator to a selected transmitter and a selected rectifier in response to a dialing signal. The other relays act as control and power distribution relays for the modulator. Two receptacles mounted on the chassis are used to make all the l-v (low-voltage) connections while the h-v connections are made to three terminals mounted on stand-off insulators.

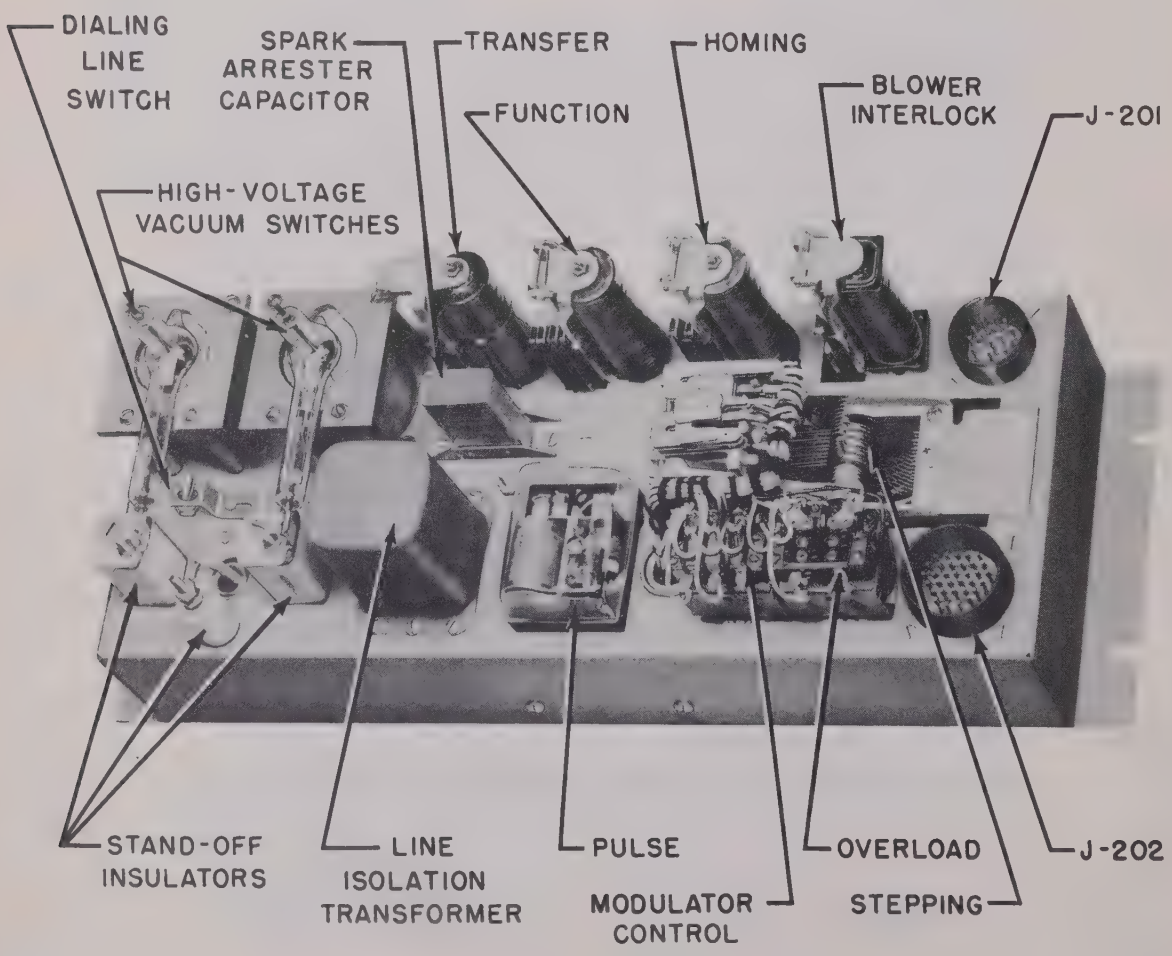


Figure 8. Modulator Type 50H, dialing and auxiliary relay unit

e. Control Panel. The control panel is located between the first and second shelves in the center of the cabinet. It consists of two switches and a dial mounted on the panel. The DRIVER CURRENT and AUDIO LEVEL switches are mounted across the lower portion of the assembly. The dial, which is similar to a telephone dial, is mounted at the top of the panel. The switches are used to cut the two meters in and out of two circuits to provide a visual indication of the operation of four circuits. The dial is used for local control of the modulator. The manner of operation is similar to that of a telephone dial. When it is desired to select a particular transmitter to be modulated, the number corresponding to that transmitter is dialed.

f. Fuse Panel Assembly (fig. 14). The fuse panel assembly, which is located on the right-hand side of the cabinet assembly, consists of a panel with 10 fuses mounted on it. The fuses are labeled in pairs and these labels indentify the fuses as to circuit function. These fuses are of the cartridge type and are held in sockets by means of screw type caps. The labels for the fuses are as follows: from left to right on the top row, the first two fuses are labeled "RECT FILA," the next pair is labeled "450TL FILA." In the second row, reading from left to right, the first pair is labeled "BIAS," the second pair "LOW VOLTAGE." The two fuses in the bottom row are labeled "BLOWER."

g. Blower Assembly. The blower assembley, which is mounted toward the rear of the cabinet between the second and third shelves, consists of an induction motor and an impeller. This blower assembly draws air from the outside of the cabinet through a filter, forces it down through the lowest compartment, then up past the various components of the unit, through the amplifier chassis, and out through a perforated metal screen in the top of the cabinet.

h. Terminal Board. The terminal board extends from the second to the third shelf at the front of the unit. It consists of a panel upon which are mounted five connector blocks which are labeled for circuit identification. Connections to the terminal board are made by screw and lug assemblies.

i. Filter Reactor, Filter Capacitor, and Modulation Transformer. The filter capacitor, filter reactor, and modulation transformer are located in the bottom of the unit. They are accessible either from the rear, or from the front after removal of the safety panel which does not have an interlock. These three units are h-v equipment. Connections to these units are made by wires fitted with lugs which are bolted to the terminals on the top of the standoff insulators.

9. Minor Components

No minor components are supplied with Modulator Type 50H.

10. Running Spares (Optional Equipment)

A group of running spares is supplied with each modulator. Spares are provided for all normally expendable items such as tubes and fuses.

The following is a list of running spares:

20 fuses, 1 amp, 250 volts.
20 fuses, 2 amp, 250 volts.
10 fuses, 2.5 amp, 250 volts.
1 tube type 12AU7.
2 tubes type 807.
2 tubes type 5R4GY.
1 tube type 5Y3GT.
1 tube type 845
1 tube type 450TL.

11. Additional Equipment Required

The following equipment is not supplied with Modulator Type 50H, but it is necessary for the full operation of the equipment.

Radio Transmitter (Wilcox "96" series).
Rect. Power Unit (Wilcox "36" series).
Remote Control Console CS-212.

CHAPTER 2

OPERATING INSTRUCTIONS

SECTION I. INSTALLATION OF MODULATOR TYPE 50H

12. Interior Requirements

The shelter for the equipment must meet the following requirements:

a. The floor must be capable of sustaining the weight of the equipment without vibration. Total weight of the equipment used with the modulator can be determined from the table below, which lists the weight of each unit:

Unit	Weight (lb)
Modulator Type 50H	775
Rectifier Power Unit (Wilcox "36" series)	1,895
Radio Transmitter (Wilcox "96" series)	320

b. Sufficient space must be available for possible repair work, permitting door swing as explained in subparagraph d below. (Note that the front doors of the modulator are of the type which may be lifted off when open.).

c. The ceiling height must be at least 9 feet to allow for r-f (radio-frequency) transmission line installation to the transmitters.

d. Sufficient space must be allowed behind the equipment to permit removal of the rear panels, and sufficient space must be allowed at one end of the installation so that it is possible to walk to the rear of the equipment. Figure 9 shows the floor space required when one Modulator Type 50H, one rectifier Power Unit (Wilcox "36" series), and three Radio Transmitters (Wilcox "96" series) are grouped together as an installation. Except for these limitations, the equipment may be located anywhere convenient to the transmission lines and power source.

e. Adequate lighting for day and night operation must be provided. Position the equipment so that the panel designations and meters may be read easily. Artificial lighting should be arranged so that the light falls directly upon the instruments and control panels. A portable drop lamp and extension cord are convenient assets for the operating and maintenance personnel.

13. Uncrating, Unpacking, and Checking New Equipment

Note. For used or reconditioned equipment, refer to paragraph 18.

a. General. Equipment may be shipped in oversea packing cases or domestic packing cases (fig. 10). When new equipment is received, select a location where the equipment may be unpacked without exposure to the elements, and convenient to the permanent or semipermanent installation of the equipment. Because of the weight of the equipment, it is advisable to unpack it in the room where it is to be installed.

Caution: Be careful in uncrating, unpacking, and handling the equipment; it is easily damaged. Careless handling in the unpacking of the equipment may necessitate complete overhaul of the unit.

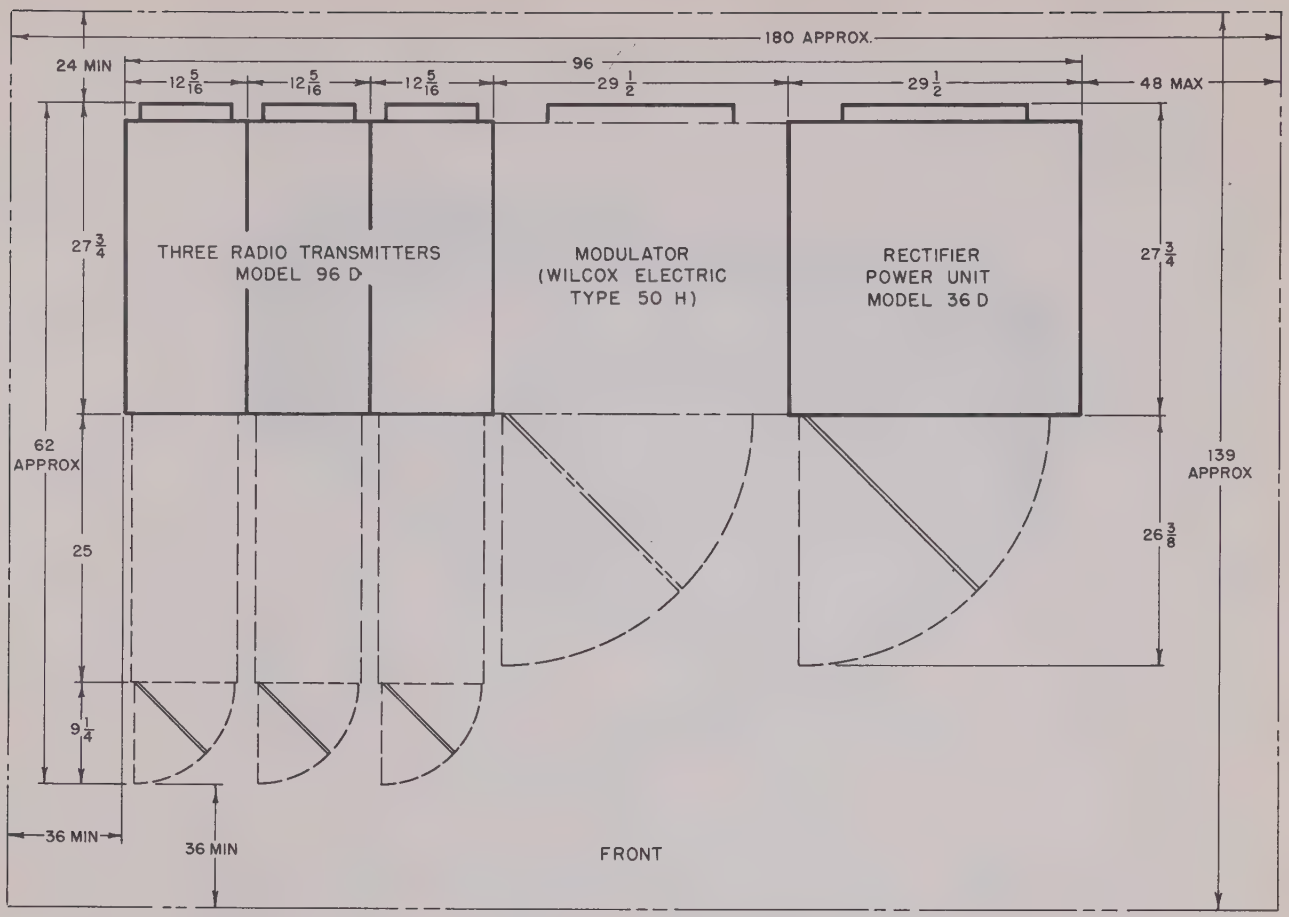


Figure 9. Floor space required for the installation of three transmitters, one rectifier, and one modulator

b. Step-by-step Instructions for Uncrating and Unpacking the Modulator Cabinet. (1) Place the largest packing case top side up as near the installation position as convenient.

(2) Cut and remove the steel straps.

(3) Remove the bottom two rolls of nails from the box with a nail puller. This holds the top and bottom of the box together. Do not attempt to pry off the sides and top; the equipment may be damaged.

(4) After removing the nails, lift the top compartment straight up and off the unit and set it aside. Use caution in lifting the box off so that it does not scratch or hit the cabinet.

(5) Remove the moistureproof barrier and shrouds from the cabinet, taking care not to damage the surface of the cabinet. Keep the barriers as near intact as possible. Loose ends of moistureproof barriers and shrouds must be turned back and out of the way before proceeding with the next step.

(6) Cut the metal straps which hold the cabinet on the mounting base. Remove the bags of silica gel, and bend the straps out of the way. If the cabinet is bolted to the base of the box, remove the nuts and packing material.

(7) Lift the cabinet vertically from the mounting and set it aside in the upright, operating position.

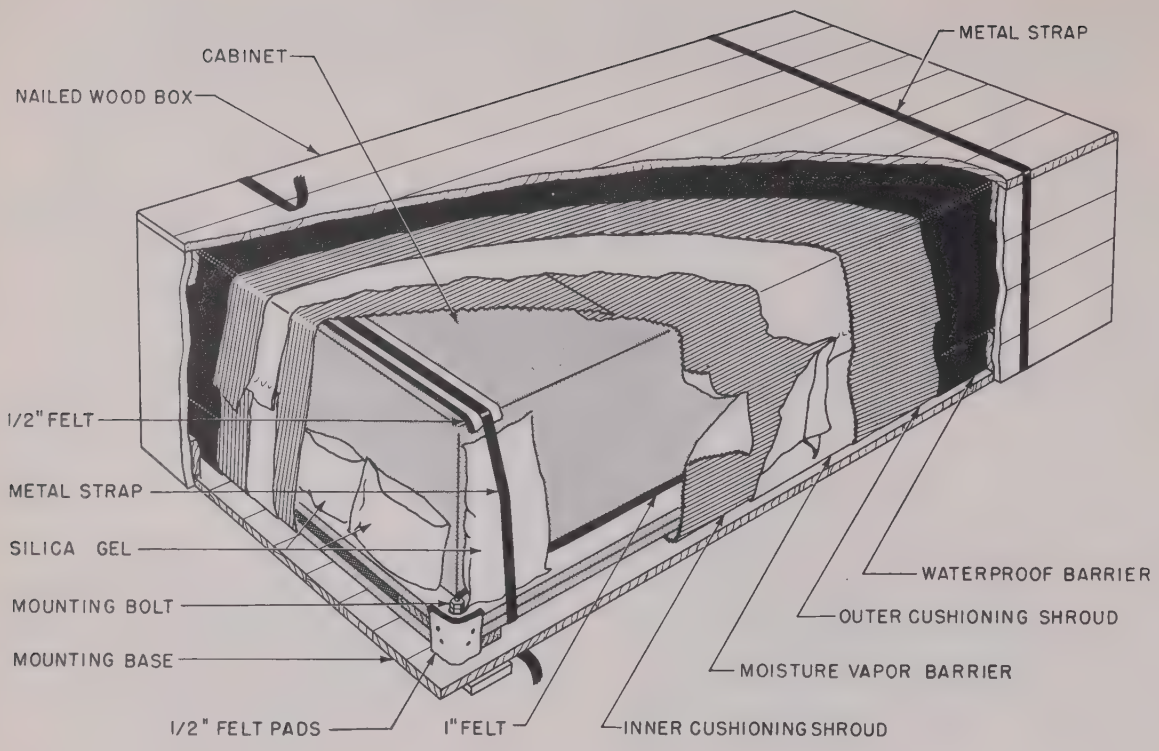


Figure 10. Typical component packed for export shipment

(8) Remove outside protection from door handles, meter panel, and remove such material as may be on the outside of the cabinet.

(9) Open the front doors. Remove interior packing, fiberboard boxes and all stowed items. Set the stowed items aside for future installation. Remove all tie-ups, blocks, and bracing from the interior of the cabinet. Cut and remove the metal straps which secure the blower assembly to shelf in cabinet.

(10) Remove the components from the fiberboard boxes that are stowed within the cabinet. Remove any padding and other shipping material from the stowed components.

c. Step-by-step Instructions for Unpacking Amplifier Chassis.

(1) Follow the above procedure for unpacking amplifier chassis. Use care in handling it.

(2) There are no stowed items within this unit.

d. Step-by-step Instructions for Unpacking and Uncrating the Modulation Transformer, Filter Reactor, and Filter Capacitor.

(1) Remove the lid from the shipping container by removing the nails with a nail puller.

(2) Remove blocking from the interior of the container by removing nails with a nail puller and lifting blocking out.

(3) Lift each item from the shipping container, removing smaller items first and setting them aside.

(4) Remove the waterproof barrier from each item. Remove the blocking brace from each item. Take precau-

tions not to damage insulators which are on top of each item.

(5) Remove the wrapping and preservative from each item. This will prepare the units for installation in the cabinet.

e. Checking. Check the contents of each container against the master packing slip.

Note. Save the original packing cases and containers. They can be used again when equipment is packed for storage or shipment.

14. Installation of Cabinet

a. General. Figure 11 gives the mounting and drilling dimensions for three transmitters, one rectifier, and one modulator. These dimensions may be readily extended to cover any number of units. The bolt holes for wood flooring or expansion bolts for concrete should be drilled before the cabinets are moved into place. In the case of steel flooring, the holes should be drilled and tapped for 1/4"-20 machine screws.

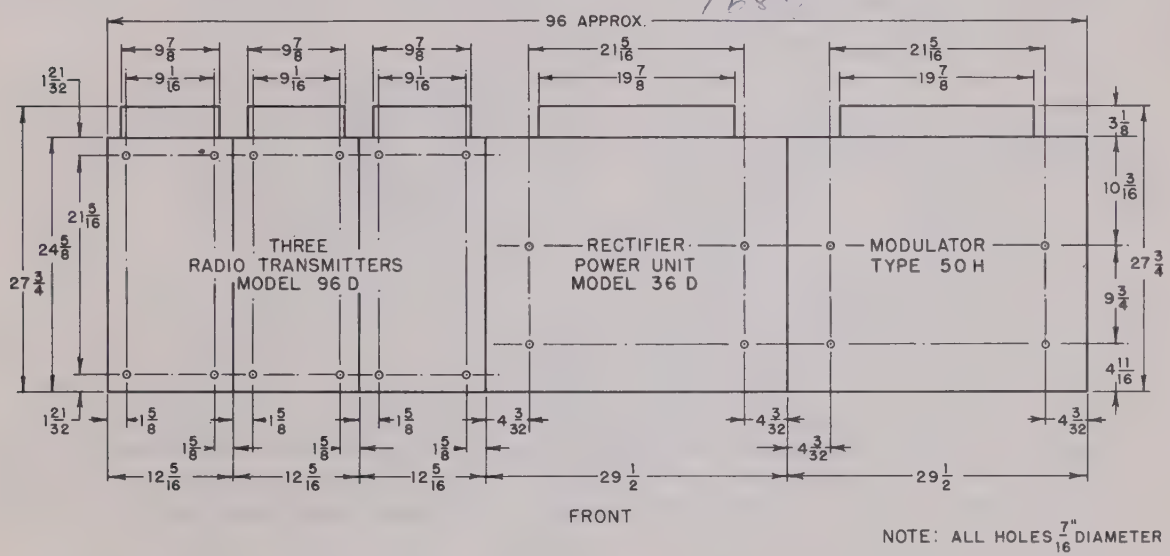


Figure 11. Mounting and drilling dimensions for an installation consisting of three transmitters, one rectifier, and one modulator

b. Mounting Cabinet. Move the modulator cabinet into place. Remove the rear door by turning the quick-release fasteners. Remove the front door and the lower panel. The front door is hung with separable hinges and can be removed by opening, then lifting the door straight up. The lower panel can be removed by taking out the top four screws and lifting the panel up and out of the cabinet. Locate the cabinet over the four holes drilled in the floor so that the holes in the cabinet line up with the holes in the floor. Secure the cabinet to the floor with four bolts which pass through the bottom shelf into the holes in the floor.

15. Installation of Modulator Components (fig. 2)

a. General. To install the components of the modulator in the modulator cabinet, the front door and the back panel must be removed in order to provide access to the interior of the cabinet. The inner doors at the front of the unit need only be unlatched for access from the front.

b. Installation of Amplifier Chassis (fig. 7). Install the amplifier chassis in the cabinet from the rear. Slide the chassis up on the first shelf with the tube sockets toward the front of the cabinet. Line up the holes in the bottom

edge of the chassis with the holes in the shelf in the cabinet and secure the chassis to the cabinet shelf with four screws and washers. Nuts for these screws are staked to the chassis. Connect the cabinet cable with plug P-1 to the receptacle on the underside of the amplifier chassis.

c. Installation of Dialing and Auxiliary Relay Unit (fig. 8). The dialing and auxiliary relay unit is mounted to the side of the cabinet between the second and third shelves (figs. 2 and 6). This unit is shipped installed in the cabinet. However, the two plugs connecting the cabinet cables to the unit should be checked to see that they are tightened securely in the receptacles on the unit.

d. Installation of Modulation Transformer, Filter Reactor, and Filter Capacitor. The modulation transformer, filter reactor, and filter capacitor are installed in the cabinet on the bottom shelf. These units can be installed from either the front or rear of the cabinet. Mount the units in place and secure them to the bottom of the shelf by means of screws and lockwashers. Complete the electrical connections as shown in figure 12. The ground wire to capacitor C-1 is located under the roof of the above deck and is tied with tape to the main cable together with the interconnection wiring between C-1, L-1, and T-1.

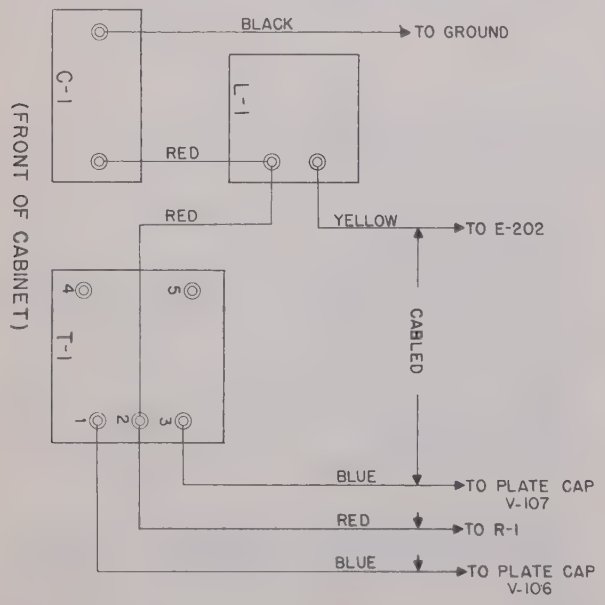


Figure 12. Modulator Type 50H, connection of components on bottom shelf

e. Installation of Tubes (fig. 13). Remove the tubes from the containers. The modulator requires 13 tubes; 1 type 12AU7 tube, 3 type 807 tubes, 2 type 845 tubes, 2 type 450TL tubes, 4 type 5R4GY tubes, and 1 type 5Y3GT tube. All the tubes in the modulator are mounted on the amplifier chassis.

To install the tubes, proceed as follows:

(1) Line up the pins of tube V-101, a type 12AU7 tube, with the holes in the tube socket. This tube is at the front of the chassis at the right side. Slide the tube into the socket firmly. Install the metal cover over the tube and lock.

(2) Insert tubes V-102, V-103, and V-113; these are type 807 tubes, install tubes V-108, V-109, V-110, and V-111, which is a type 5R4GY, and tube V-112, which are type 5Y3GT by alining the key on the tube base with the keyway in the tube socket. Push the tube in until firmly seated. Connect the leads to the caps of V-102, V-103, and V-113.

(3) Tubes V-106 and V-107, type 450TL tubes, are installed by lining up the key on the tube base with the keyway in the slot and pushing the tubes in, then turn the tube a quater-turn clockwise until they are in a locked position. Connect a grid lead to the cap on the side of each tube. Connect a plate lead which comes from the cabinet to each cap at the top of the tube. Installation of these two tubes is easier if tube V-107 is installed first.

(4) Tubes V-104 and V-105, type 845 tubes, are installed by lining up the pin on the tube base with the slot in the tube socket, pushing the tube in and giving it a quarter-turn clockwise until the tube is in a locked position.

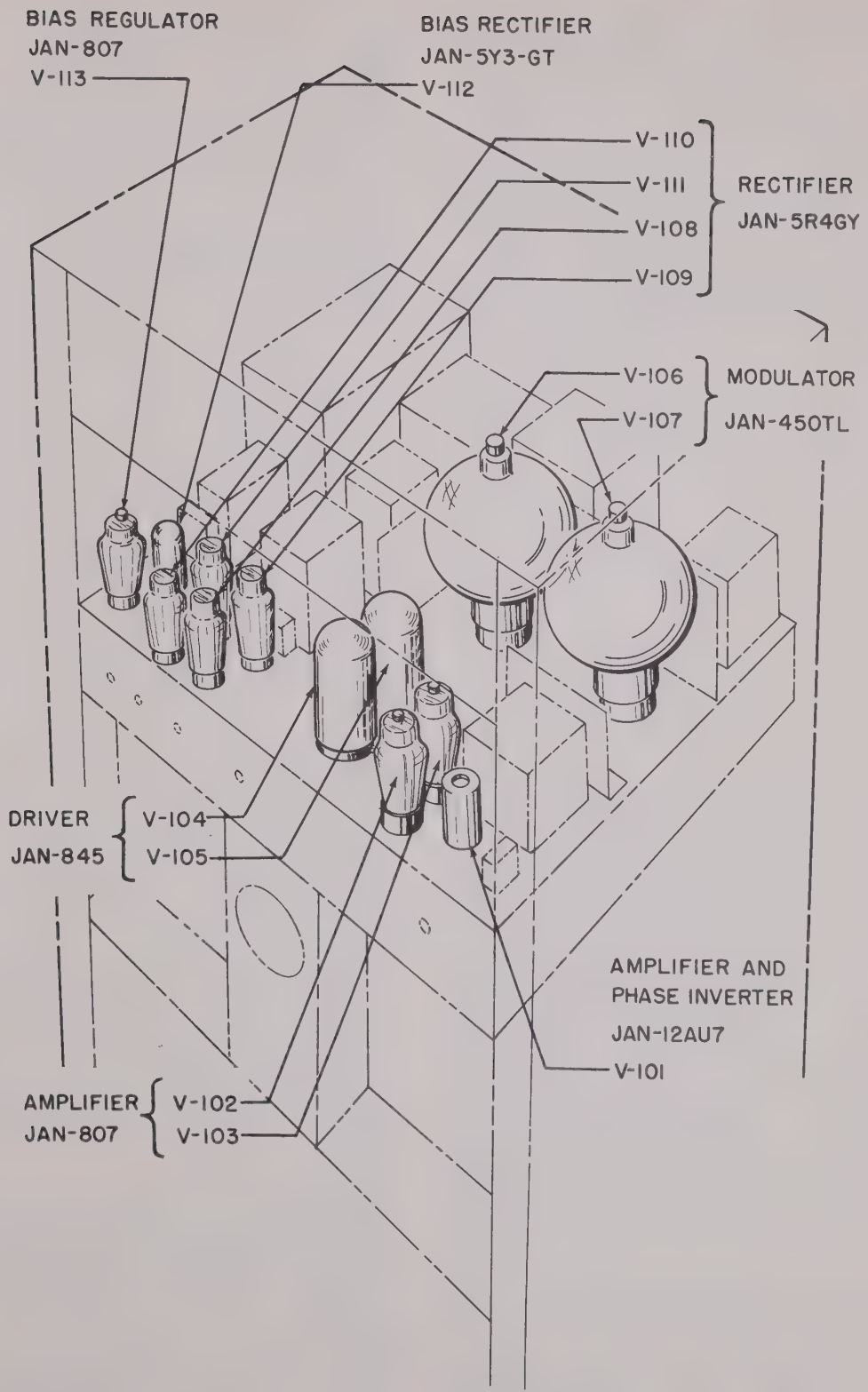


Figure 13. Modulator Type 50H, tube location diagram

f. Installation of Vacuum Switches. The h-v vacuum switches are mounted on the dialing and auxiliary relay unit. Carefully insert each of the glass-inclosed vacuum contacts into position, through the coil and into the clips inside the relay unit. The long leg of the contact with the round straight cylinder inside goes through the coil. Press the other pin terminal carefully into the spring clip mounted on the stand-off insulators, E-201 and E-203. No connection is made to the short leg of the contacts.

g. Installation of Fuses (figs. 2 and 14). All fuses are installed on a panel which is between the first and second shelves on the right-hand side of the cabinet. Access to these fuses is from the front of the unit. Ten fuses of the cartridge type are fitted into sockets on the panel and held in place by caps with treaded fittings. Below is a table giving rating, type, symbol designation, and circuit identification.

Symbol	Circuit identification	Rating
F-1, F-2	Blower B-1	2.5 amps, 250 volts (slow-blow)
F-3, F-4	Bias supply transformer T-106	1 amp, 250 volts
F-5, F-6	Filament transformer for 450TL tubes, T-103	2 amps, 250 volts (slow-blow)
F-7, F-8	Low voltage plate supply transformer T-104	2 amps, 250 volts (slow-blow)
F-9, F-10	Rectifier filament transformer T-105	1 amp, 250 volts

16. Connections Between Units (fig. 38) Connections between the various units depend on the installation. The entire installation may consist of only two transmitters, one modulator, one rectifier power unit, and one remote control console. Another type of installation may consist of six transmitters, two rectifier power units, two modulators, and three remote control consoles. A separate book provides specific information for the connection of Remote Control Console (Wilcox CS-212). After all connections are completed, reinstall all doors and panels that were removed to give access to the interior of modulator.

17. Initial Adjustment of Modulator Type 50H

a. Transformer Tap Adjustments. When the a-c line voltage differs appreciably from the normal value of 220 volts ac, it is necessary to change the connections of the transformers to insure correct out-put from the transformers. All the transformers, except the modulation transformer T-1, the coupling transformer T-101, and the line insolation transformer T-201 have taps on the primary windings to provide adjustment to compensate for varying line voltage. The line insolation transformer T-201 has taps on the primary side for impedance matching. To make line voltage compensating adjustments proceed as follows:

(1) Adjustment of taps on transformers T-102, T-103, T-104, T-105, and T-106. All these transformers have taps on the primary windings to correct the output voltage when a variation in line voltage occurs. These transformers are factory-connected for correct output when the line voltage is 220 volts ac. When the line voltage variation is great

enough to affect the operation of the equipment, the connections to the taps on the primary windings must be changed to obtain the correct output voltage. The taps are labeled 2, 3, 4, and 5 to provide connections for a-c line voltages of 210, 220, 230, and 240 volts, respectively. Tap labeled 1 is common (fig. 37)

(2) Line Isolation Transformer T-201. Taps are provided on the primary winding of this transformer for matching the input load impedance of the line. The transfomer is factory-connected for a balanced input of 500 ohms. When the input impedance differs from this, the connections must be changed. Taps are provided for 50, 125, and 500-ohm impedance balanced to ground. For 50 ohms, connect the line to terminals 5 and 8; for 125 ohms, connect to 4 and 9; and for 500 ohms, connect to 3 and 10.

b. Simplex-parallel (Dialing Line) (S-201). The input of the dialing line circuit may be adapted to be used with either parallel or simplex types of telephone dialing lines. Switch S-201, on top of the dialing and auxiliary relay unit chassis, must be switched to the position corresponding to the type of line used. The two positions are clearly marked. This switch is factory-set for parallel operation. To change the position of the switch, loosen the lock provided to secure the switch handle against accidental operation, throw the switch to the proper position, and tighten the lock. When Modulator Type 50H is used with Remote Control Console Type CS-212, switch S-201 should be set to the PARALLEL position. (Other consoles may require a change).

c. Adjustment of Bias Protection Control (R-129). This control is factory-adjusted (and sealed with glyptol) so that the protective feature operates when the bias supply voltage falls to approximately 70 to 75 percent of normal value, therefore, adjustment should not be needed. If necessary to make this adjustment, have the modulator in operating condition with no audio input voltage applied. Rotate R-129 completely counterclockwise and then rotate clockwise slowly until the bias protection relay 0-101 starts to alternately open and close as evidenced by the filament of V-106 and V-107 glowing alternately off and on. Then rotate the control counterclockwise about 5^{o} beyond the point where the relay remains closed.

d. Bias Adjustment (R-133). This control is factory-adjusted and sealed to give a bias voltage of 220 volts (the correct value when the high voltage supply is 4,200 volts). Clockwise rotation of the control increases the bias voltage. Adjust this control to give the proper bias voltage as indicated by MODULATOR BIAS meter. For a h-v supply differing from 4,200 volts, adjust the bias voltage as follows: for each 100 volts increase over 4,200 volts, raise the bias supply 5 volts above 220 volts; for each 100 volts decrease from 4,200 volts, lower the bias supply 5 volts from 220 volts. The bias voltage must be adjusted with no audio signal applied but with the modulator in operating condition.

Note. Check with paragraph 66, typical meter readings. Do not disturb adjustment if meter readings are same.

e. Audio Level Adjustment (R-120). This adjustment must be made with the modulator in operating condition and a constant tone in the range of 1,000cps, applied to the input. Set the audio gain so the carrier of Radio Transmitter Type 50H is modulated approximately 95 percent, or if a dummy load is used for the modulator so the power output is 1,600 watts. If facilities are not available for determining modulation percentage or power output, use a 1,000-cps signal and set the audio gain so that the MODULATOR meter M-3 reads 580 ma (milliamperes), with known good tubes in the amplifier. Press the AUDIO LEVEL switch down to the OUTPUT position. The AUDIO LEVEL meter should read zero db. Control R-120 is adjusted (and sealed) at the factory to make the meter read zero db when the modulator output is 1,600 watts (par. 74).

f. Overload Adjustment (R-138). This adjustment is set (and sealed) at the factory to operate at approximately 750 ma total modulator current as indicated by MODULATOR meter M-3; adjustment should not be needed unless overload does not operate at this reading. This adjustment is preferably made with the output of the modulator connected to a dummy load. If the modulator output is connected to a transmitter, the carrier will be overmodulated causing spurious radiation and possible interference. Apply a constant tone of about 1,000 cps to the modulator input. Set the audio gain so the MODULATOR meter reads 750 ma. Adjust R-138 to the point where the overload relay just operates. Clockwise rotation of R-138 increases the current value at which the overload relay operates. Do not operate the modulator at this current value for more than 5 minutes at a time.

g. Audio Gain Adjustment (R-101). This control is not adjusted at the factory. The adjustment must be made for each particular installation since it depends primarily on the amount of audio voltage available at the modulator input during normal station operation. The purpose of this control is to adjust the over-all gain (amplification) of the modulator so that the transmitter carrier will be modulated as high as possible without exceeding 100 percent modulation on peaks. The best method of adjustment requires an accurate method of measuring carrier modulation. If such equipment is available, adjust R-101 so that with normal voice or tone input to the modulator, the modulation peaks of the carrier do not exceed 100 percent or exceed this value only slightly. If modulator measuring equipment is not available, control R-101 must be adjusted using MODULATOR meter M-3 to indicate the output of the modulator. If it is known that the equipment at the remote control unit is adjusted so that the peak amplitude of the fixed audio tone used for modulation is the same as the peak output of the microphone amplifier, the gain of the modulator can be adjusted using the fixed tone and will be correct for voice. Use a cathode ray oscilloscope to compare the peak voltages of the fixed and voice tones. Simply adjust R-101 so that with the normal fixed tone applied to the modulator, meter M-3 reads approximately 580 ma. If it is necessary to adjust the gain with voice input to the modulator, have the operator talk into the microphone in the normal manner, keeping the level of his voice as steady as possible, and set R-101 to make meter M-3 read approximately 300 ma on peaks (par. 66, typical panel meter reading).

h. Spark Gap Adjustments. The modulation transformer T-1 and the filter reactor L-1 are equipped with spark gaps to protect these units against h-v surges. At sea level, the spark gap on the modulation transformer should be adjusted to 7/64-inch clearance. At an altitude of 5,000 feet this clearance should be increased to 1/8 inch, and at 10,000 feet increase the gap to 9/64 inch. The spark gap on the filter reactor should be adjusted to 1/16-inch clearance for any altitude between sea level and 10,000 feet.

18. Service Upon Receipt of Used or Reconditioned Equipment

a. Follow instructions in paragraph 13 for uncrating, unpacking, and checking the equipment.

b. Check the used or reconditioned equipment for tags or other indications pertaining to the wiring of the equipment. If any changes of wiring have been made, make a note of the changes in this instruction book, preferably on the schematic diagram.

c. Check the operating controls for ease of rotation. If lubrication is required, refer to the lubrication instructions in chapter 3, section III.

d. Perform the installation and connection procedures given in paragraphs 14, 15, and 16.

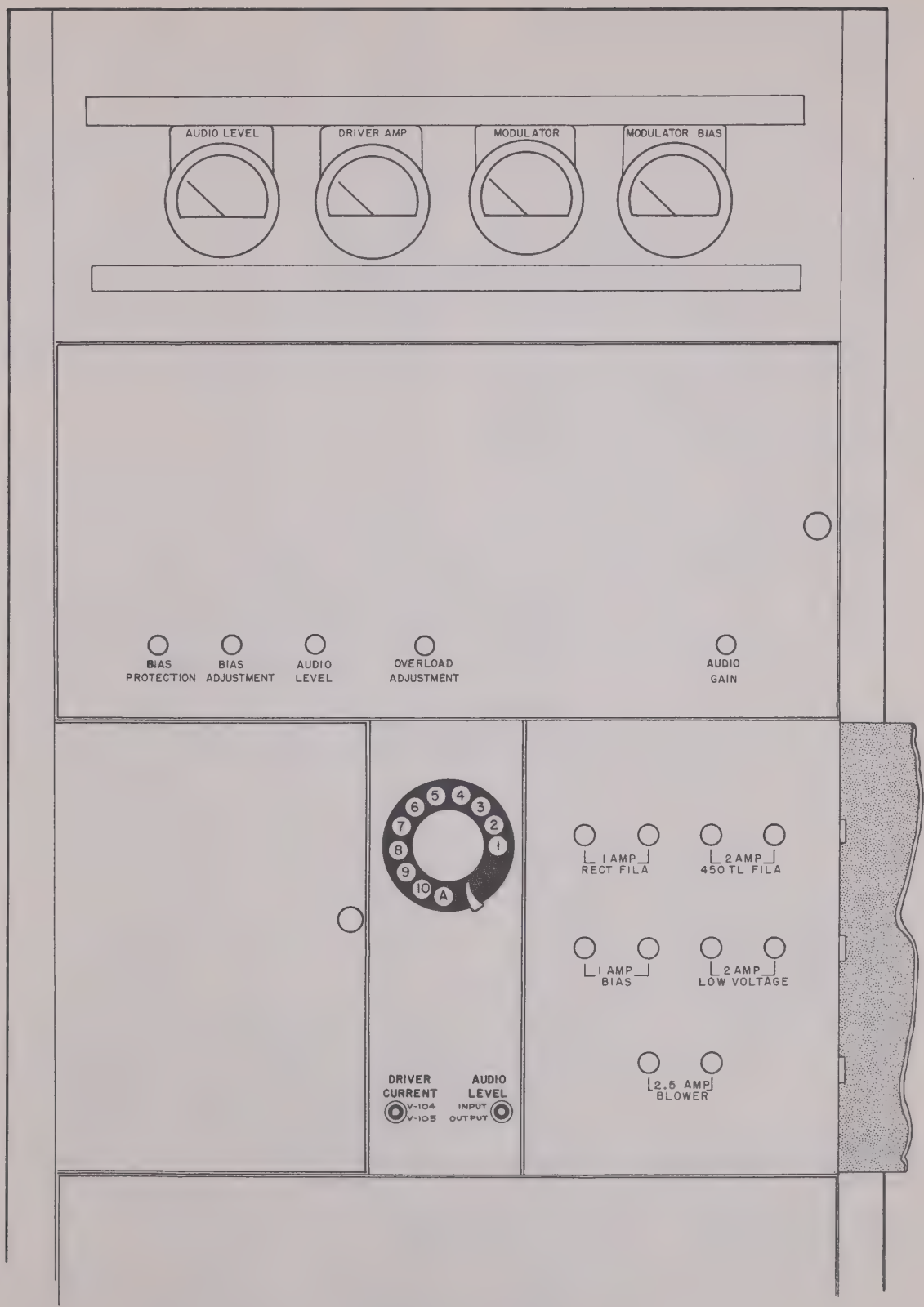


Figure 14. Modulator Type 50H, location diagram of controls, instruments and fuses

SECTION II. CONTROLS AND INSTRUMENTS

19. General

Haphazard operation or improper setting of the controls can cause damage to electronic equipment. For this reason it is important to know the function of every control. The actual operation of the equipment is discussed in sections III and IV of this chapter.

20. Modulator Type 50H Controls and Instruments (fig. 14).

The controls and instruments on the modulator are located as follows: Across the top are four meters; on the amplifier chassis which rests on the first shelf, are five screw-driver adjustments which are accessible when the front door of the cabinet is open; on the dialing and auxiliary relay chassis is the SIMPLEX PARALLEL switch; and in the center of the cabinet between the first and second shelves are the dialing switch and two toggle switches. The following table lists the controls and instruments of the modulator and describes their function.

Control or instrument	Function
AUDIO LEVEL meter (M-1)	With the AUDIO LEVEL switch in the INPUT position, it measures the audio voltage at the input to the amplifier. With the switch in the OUTPUT position, it furnishes arbitrary indication, adjusted by AUDIO LEVEL control (R-120), of the audio voltage at the modulator tube grids.
DRIVER AMP meter (M-2)	Measures the plate current of either driver tube (V-104 or V-105) depending on the position of the DRIVER CURRENT switch (S-2).
MODULATOR meter (M-3)	Measures total current of the modulator tubes (V-106 and V-107).
MODULATOR BIAS meter (M-4)	Measures the amount of grid-bias voltage applied to the grids of the modulator tubes.
BIAS PROTECTION (R-129) (screw-driver control)	Determines the voltage at which the bias protection relay opens.
BIAS ADJUSTMENT (R-133) (screw-driver control)	Determines the amount of bias voltage applied to the grids of the modulator tubes.
AUDIO LEVEL (R120) (screw-driver control)	Used in conjunction with the AUDIO LEVEL meter (M-1) to adjust the arbitrary meter indication at the grids of the modulator tubes. Set at factory to give zero db meter indication when modulator output is 1,600 watts (approximately 95 percent modulation of Radio Transmitter (Model "96" series) at 1,000 cps.
OVERLOAD ADJUSTMENT (R-138) (screw-driver control)	Determines the amount of modulator plate current at which the overload relay operates.
AUDIO GAIN (R-101) (screw-driver control)	Determines the amount of audio voltage applied to the grid of input tube V-101.
DIAL (I-1)	Used to connect the modulator to the particular transmitter selected for modulation. Used only for local control or checking of operation.

Control or instrument	Function
AUDIO LEVEL switch (S-1)	A DPDT (double-pole double-throw) switch which connects the AUDIO LEVEL meter (M-1) into either the grid circuit of the modulator tubes or the input audio line.
DRIVER CURRENT switch (S-2)	A SPDT (single-pole double-throw) switch which connects the DRIVER AMP meter (M-2) into the cathode circuit of either tube in the driver stage. This stage consists of two tubes, V-104 and V-105.
SIMPLEX-PARALLEL switch (S-201)	A DPDT toggle switch which adapts the dialing line input circuit to the type of dialing line used for remote control of the modulator.

SECTION III. OPERATION UNDER USUAL CONDITIONS

21. Starting Procedure

Modulator Type 50H is a part of a large fixed installation which may consist of one or more rectifiers, from one to ten transmitters, and from one to ten remote control units. Before the modulator can be used, the remote control equipment, rectifiers, and transmitters must be in good operating condition. Since the operation of the transmitters and rectifiers is described in detail in another book, and the operation of the remote control console is given in Wilcox Manual CS-212, their operation is not covered here.

Note. If, during the starting procedure, an abnormal result is obtained, see paragraph 43, equipment performance checklist.

a. Close the three-phase a-c power switch (usually wall-mounted). Close the circuit breaker on the rectifier. Press the START button on the rectifier. This immediately applies 220 volts ac and 12 volts dc power to the modulator.

b. The blower motor in the modulator should start immediately and all the tubes except V-106 and V-107 should light.

c. Within 30 seconds, the MODULATOR BIAS meter should indicate approximately 220 volts when the h-v plate supply is 4,200 volts. If it differs appreciably from this value, adjust the BIAS ADJUSTMENT control with a screw driver until the meter indicates the correct value. For each 100 volts over 4,200 volts, the bias supply should be increased 5 volts; and for each 100 volts under 4,200 volts, the bias supply should be decreased 5 volts.

Caution: Make certain that the carrier of the desired channel is off before performing the next operation.

d. At the remote control unit, depress one of the transmitter selector switches and dial the number for the corresponding transmitter. Do not dial before depressing the desired selector switch. Key the transmitter. If the underload relay in the transmitter is correctly adjusted, the modulator will become operative as indicated by tubes V-106 and V-107 lighting and Modulator meter M-3 reading approximately 80 ma with no audio signal. An audio signal applied to the modulator input will now amplitude-modulate the transmitter carrier (par. 66).

e. Local starting of the modulator for testing purposes is accomplished by operating the dial on the modulator control panel after the desired transmitter has been selected, either remotely or locally. Dial the same number locally as would be dialed remotely.

Caution: In all cases, before dialing,

check to see that the desired transmitter is not operating from a local position or from another console position.

22. Types of Operation

The modulator is designed to voice modulate or continuous tone modulate the carrier of any one of the associated transmitters. The type of operation for which the modulator is to be used is determined by the operator at the remote control position. Only am. (amplitude modulation) is possible.

23. Stopping Procedure

a. Release the transmitter key at the remote control unit. This will remove power from the filaments of tubes V-106 and V-107 and MODULATOR meter M-3 will read zero. Release the transmitter selector switch. The stepping relay in the dialing and auxiliary relay unit will return to home position and the modulator will be released to stand-by condition to be used again as desired. However, do not dial until the transmitter carrier key is released.

b. If the transmitter is selected and keyed locally, release of the local key and channel switch will release the modulator to stand-by condition.

c. To remove all power from the modulator push the STOP button and open the circuit breaker on the rectifier. If the equipment is to be inoperative for a long time, open the three- phase a-c power switch. This switch is usually wall-mounted.

SECTION IV. OPERATION UNDER UNUSUAL CONDITIONS

24. General

Modulator Type 50H is designed to operate under the conditions listed in the table below:

Temperature		Humidity	Altitude	
Maximum	Minimum		Maximum	Minimum
+75°C (+167°F)	-55°C (-67°F)	100 % with condensation	10, 000 ft	Sea level

However, the operation of the equipment may be difficult in regions where extreme cold, heat, humidity and moisture, sand conditions, etc. prevail. In the following paragraphs, instructions are given on procedures for minimizing the effects of these unusual operating conditions.

25. Operation in Arctic Climates

Subzero temperature and climatic conditions associated with cold weather affect the efficient operation of the equipment. Instructions and precautions for operation under such adverse conditions are as follows:

a. Handle the equipment carefully.

b. Locate the equipment inside a heated inclosure where there is no danger of a cold draft striking the glass tubes when a door is open. A sudden draft of cold air is often sufficient to shatter the glass envelope of a heated tube. If the inclosure is so constructed that this precaution is impossible, place a blanket or some other barrier between the source of the draft and the equipment.

c. When equipment which has been exposed to the cold has been brought into a warm room it will start to sweat

and continue to do so until it reaches room temperature. When the equipment has reached room temperature, dry it thoroughly. This condition also arises when equipment warms up during the day after exposure during a cold night.

26. Operation in Tropical Climates

When operated in tropical climates, radio equipment may be installed in huts where ventilation is very poor. The high relative humidity causes condensation of moisture on the equipment whenever the temperature of the equipment becomes lower than the ambient air. To minimize this action, place any means of heating near the equipment, such as large electric bulbs.

27. Operation in Desert Climates

a. The main problem which arises with the equipment operation in desert areas is the large amount of sand or dust which enters the moving parts of radio equipment. The ideal preventive measure is to house the equipment in a dustproof shelter. Since, however, such a building is seldom available and will require air conditioning, the next best precaution is to make the building in which the equipment is located as dustproof as possible with available materials. Hang wet sacking over the windows and doors, and cover the inside walls with heavy paper.

b. Be careful to keep the equipment as free from dust as possible. Make frequent preventive maintenance checks. Pay particular attention to the condition of the lubrication of the equipment. Excessive amounts of dust, sand, or dirt that come into contact with oil result in grit, which will damage the equipment.

CHAPTER 3

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

SECTION I. ORGANIZATIONAL EQUIPMENT

28. Tools and Materials Supplied with Modulator Type 50H

Tools and materials issued for but not necessarily included with Modulator Type 50H are listed in subparagraphs a and b below.

a. Tools.
1 Tool Equipment.

b. Materials.
Orangestick.
Cheesecloth, bleached, lint-free.
Carbon tetrachloride.
Sandpaper, #0 0 0 0.
Oil, engine #0. E. 10.
Solvent, dry-cleaning (SD) (Fed spec. No. P-S-661a).

29. Special Tools Issued

No special tools are issued for Modulator Type 50H.

SECTION II. PREVENTIVE MAINTENANCE SERVICES

30. Definition of Preventive Maintenance

Preventive maintenance is work performed on equipment (usually when the equipment is not in use) to keep it in good working order so that break-downs and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from trouble shooting and repair since its object is to prevent certain troubles before they occur.

31. General Preventive Maintenance Techniques

a. Use #0000 sandpaper to remove corrosion.

b. Use a clean, dry, lint-free cloth for cleaning.

(1) If necessary, except for electrical contacts, moisten the cloth or brush with solvent, dry-cleaning (SD); then wipe the parts dry with a cloth.

(2) Clean electrical contacts with a cloth moistened with carbon tetrachloride, then wipe them dry with a dry cloth.

c. If available, dry compressed air may be used, at a line pressure not exceeding 60 pounds per square inch, to remove dust from inaccessible places. Be careful when using this method; mechanical damage from the air blast may result.

32. Performing Preventive Maintenance

The following preventive maintenance operations should be performed by organizational personnel at the intervals indicated, unless these intervals are reduced by the local commander.

Caution: Do not tighten screws, bolts, and nuts carelessly. Fittings tightened beyond the pressure for which they are designed will be damaged or broken.

DAILY

1. Clean exterior of cabinet.
2. Check meter readings.

WEEKLY

Caution: Disconnect all power before performing the following operations. Upon completion, reconnect all power and check equipment for satisfactory operation.

1. Clean interior of cabinet, exterior of all chassis, and all chassis and parts accessible without removal from the cabinet.
2. Inspect filter capacitors C-1, C-108, C-109, and C-111 for leakage of oil or dielectric, for bulging, and for overheating.
3. Inspect power transformers T-102 through T-106 on modulator chassis and T-1 in base of cabinet for excessive heating.
4. All terminal boards for loose connections.
5. All cables for cracked, cut, or frayed insulation.

MONTHLY

Make visual inspection of the following; tighten and/or clean if necessary.

1. Tube sockets and pins, for loose contacts, dirt, and corrosion. Check vacuum tubes V-101, V-102, V-103, V-108, V-109, V-110, V-111, V-112, and V-113 with tube tester; replace if necessary. Note that tubes including final letter W or Y in the nomenclature can replace tubes of the same type without final letter W or Y. For example, tube type 12AU7W can replace tube type 12AU7.
2. Inspect all fuses and fuse holders for corrosion, cracks, and lack of tension sufficient to insure good contact.
3. Clean meter faces with a dry cloth (use solvent (SD), if extremely dirty).

QUARTERLY

Make visual inspection of the following; tighten and/or clean if necessary.

1. Tube sockets and pins, for loose contacts, dirt and corrosion. Check vacuum tubes V-101, V-102, V-103, V-108, V-109, V-110, V-111, V-112, and V-113 with the tube tester; replace if necessary. Note that tubes including final letter W or Y in the nomenclature can replace tubes of the same type without final letter W or Y. For example, tube type 12AU7W can replace tube type 12AU7.

QUARTERLY (contd)

2. All filter capacitors, for corrosion at the terminals.

3. All filter chokes, for evidence of bulging, overheating, or discoloration. Inspect for loss of sealing compound.

4. All resistors, for blistering, discoloration, and other evidence of overheating. Especially note resistors R-1 and R-2 at the top of the cabinet.

5. Inspect all the switches and relays for dirt, corrosion, loose contacts, and unsatisfactory mechanical action. Inspect the interlock switches S-3, S-4, and S-5 for security of mounting and for clean contacts.

6. The following multiple connectors, for dirt, corrosion, and loose contacts: P-1, P-2, P-3, J-201, J-202, and J-101.

7. All wires, cords, and cables, for cracked, cut, or frayed insulation.

8. All terminal boards for cracks, dirt, and loose connections.

9. The following potentiometers for unsatisfactory mechanical operation: R-101, R-120, R-129, R-133, and R-138

Note. If the potentiometers are sealed with glyptol, do not break the seal unless absolutely necessary to make the adjustment.

10. All mountings, machine screws, and nuts, for mechanical looseness.

11. All visible terminals and connections, for looseness and corrosion.

12. Moisture-fungiproof coating for breaks. (Retouch with a brush, if necessary.)

13. Finish for scratches, bare spots, and rust. (Retouch, if necessary.)

14. All insulators for cracks and dirt.

15. Metallic rectifier CR-201 for loose connections and dirt.

16. Ventilating openings in cabinet for dirt. Clean openings when necessary by using solvent (SD) and blowing compressed air through them.

17. All the relay contacts for pits and build-ups and for improper alinement. Note the wiping contacts on the switching relay K-201.

18. Air filters, for dirt. Refer to paragraph 34, for complete instructions on cleaning.

19. The blower assemblies for corrosion, loose mounting, overheating, and improper impeller action.

20. Inspect the h-v relays 0-208 and 0-209 for discoloration, cracks in glass envelope, or other evidence of failure. Replace, if necessary.

SECTION III. LUBRICATION

33. Lubrication Instructions

a. General. (1) The type of lubricant to be used, the interval, and the specific instructions for each lubrication point are given for the modulator cabinet in figure 15, and for the stepping relay in figure 16 and subparagraph c below.

(2) Gasoline will not be used as a cleaning fluid for any purpose. When the equipment is overhauled or repairs are made, parts should be cleaned with solvent (SD).

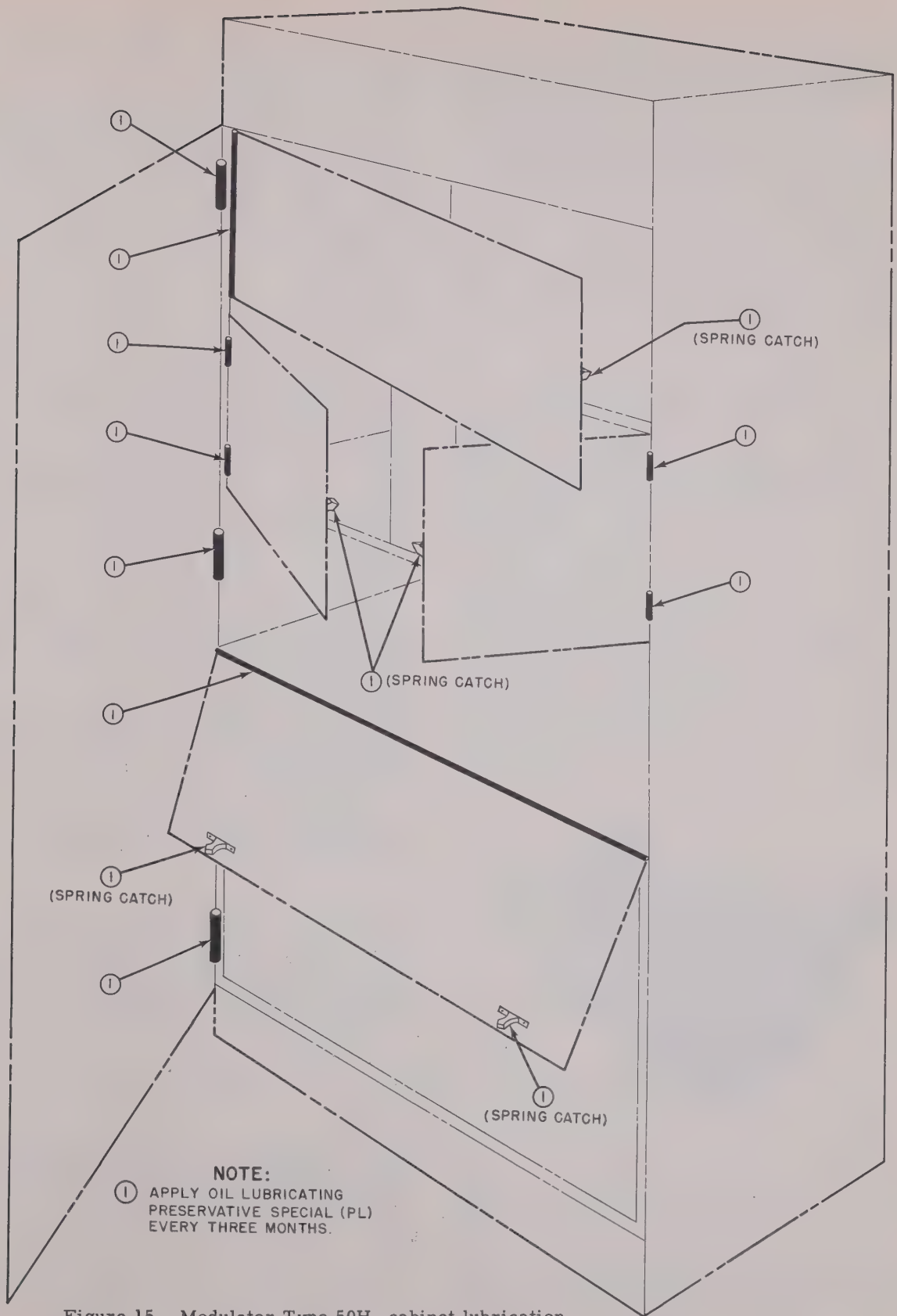


Figure 15. Modulator Type 50H, cabinet lubrication

(3) Carbon tetrachloride will be used as a cleaning fluid only in the following cases: for cleaning electrical equipment where inflammable solvents cannot be used because of fire hazard and for cleaning electrical contacts, including plugs, relay contacts, switch contacts, etc.

b. Modulator Type 50H. Open the doors on the front and wipe the hinges with a clean, lint-free cloth. Lubricate the door hinges as specified in figure 15.

c. Stepping Relay K-201. Lubricate every six months. Before lubricating, clean with carbon tetrachloride and dry thoroughly. Apply a thin film of medium consistency grease (#GL U.S.A. 2-134), to the ratchet wheel (point 1 as shown on fig. 16). If more than a thin film is applied, the grease may be thrown off the wheel when the relay homes. Apply only a trace of light oil, such as watch oil, to the armature shaft bearings and the actuating arm hinge pin (point 2). Do not lubricate the contacts or wiper arms. Excessive lubrication usually is more harmful than no lubrication. In extremely dusty locations, it may be necessary to clean and lubricate the relay more often.

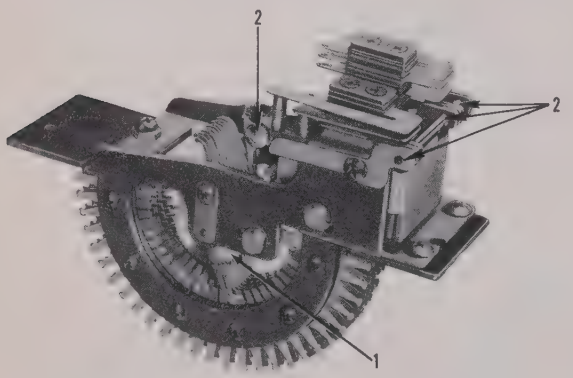


Figure 16. Stepping relay lubrication points

34. Cleaning and Lubrication of Air Filter

Caution: Do not operate equipment when air filter is out of cabinet. Remove the air filter from the back of the modulator cabinet. To clean and lubricate the filter proceed as follows:

a. Spray or wash the filter with solvent (SD) and allow to soak. If filter is very dirty, loosen the dirt with a paint brush dipped into the solvent. Wash until clean. In case of emergency use kerosene or fuel oil, in place of solvent (SD).

b. Dry the filter with a blower or compressed air.

c. Spray with oil or, if no spray gun is available, dip in oil. Use a light engine oil (O.E.-10) for normal temperatures. At arctic or temperatures below O°F, use O.E.-10A oil, and for temperatures above normal (60°F) use a thicker weight oil but in no case higher than O.E. -30 (SAE-30).

d. Let filter stand for one hour to allow excess oil to drain off, then shake vigorously to make sure there is no excess.

Note. Be careful that the filter does not retain any excess oil that may possibly flow into the cabinet and be a source of future trouble.

e. Reinstall air filter in rack at back of modulator cabinet.

35. Parts Lubricated by Manufacturer

The first chart on page 29 lists the parts lubricated by the manufacturer prior to the delivery of the equipment.

36. Parts Lubricated by Manufacturer which do not Require Subsequent Lubrication

The parts listed in the second chart on page 29 have been lubricated by the manufacturer and do not require subsequent lubrication.

Major components	Parts lubricated
Modulator Type 50H	Blower motor Stepping relay Air filter

Component	Part lubricated	Reason subsequent lubrication is not required
Modulator Type 50H	Blower motor	Permanent lubrication

SECTION IV. WEATHERPROOFING

37. Weatherproofing

a. General. Type 50H equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrossion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials. The modulator has had during manufacture, a moistureproofing and fungiproofing material applied to it. Also, the equipment has been designed to operate at any temperature between -55°C and +75°C (-67°F and +167°F).

b. Tropical Maintenance. A special moistureproof and fungiproofing treatment has been devised, which, if properly applied, provides a reasonable degree of protection. This equipment has received this treatment during manufacture.

c. Winter Maintenance. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are explained in paragraph 25.

d. Desert Maintenance. Special precautions necessary to prevent equipment failure in areas subject to extremely high temperature, low humidity, and excessive sand or dust are fully explained in paragraph 27.

e. Lubrication. The effects of extreme cold and heat on materials and lubricants are explained in paragraphs 25, 26, and 27. Observe all precautions outlined and pay strict attention to all lubrication orders when operating equipment under conditions of extreme cold or heat. Refer to paragraphs 33 to 35 for detailed instructions.

38. Rustproofing and Painting

a. When the finish on the equipment has been badly scarred or damaged, rust or corrosion can be prevented by touching up bared surfaces. Use #000 or #0000 sandpaper to clean the surface down to the bare metal. Obtain a bright smooth finish.

Caution: Do not use steel wool. Minute particles frequently enter the inside of the cabinet and cause harmful shorting or grounding of circuits.

b. When a touch-up job is necessary, apply paint with a small brush. When numerous scars and scratches warrant complete repainting, remove the components from the cabinet and spray paint over the entire cabinet. Remove rust from the cabinet by cleaning corroded

metal with solvent (SD). In severe cases it may be necessary to use solvent (SD) to soften the rust and to use sandpaper to complete the preparation for painting. Paint used will be authorized and consistent with existing regulations.

SECTION V. TROUBLE SHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

39. Scope

a. The trouble shooting and repair work that can be performed at the organizational maintenance level (operators and repairmen) is necessarily limited in scope by the tools, test equipment, and replaceable parts issued, and by the existing tactical situation. Accordingly, trouble shooting is based on the performance of the equipment and the use of the senses in determining such troubles as burned-out tubes, cracked insulators, etc.

b. The following paragraphs in this section will help determine which of the components, such as the modulator, transmitter, or power source is at fault, and then which unit of the modulator, such as, the amplifier or the dialing and auxiliary relay unit, are at fault, and will aid in localizing the fault in that unit to the defective stage or item such as a tube or fuse.

40. Visual Inspection

a. In many cases, failure of the equipment to operate properly will be caused by one or more of the following faults:

(1) Worn, broken or disconnected cords or plugs.
(2) Burned-out fuses.
(3) Defective tubes.
(4) Loose connections.
(5) Bad (dirty or broken) switch and relay contacts.

b. When failure is encountered and the cause is not immediately apparent, check as many of the above items as is practicable before starting a detailed examination of the component parts of the equipment. If possible, obtain information from the operator of the equipment regarding performance at the time the trouble occurred.

41. System Sectionalization of Trouble to a Component

System sectionalization consists of determining whether the trouble is in the modulator; transmitter, rectifier, remote control console, or power source.

a. Operate equipment on all channels on cw (continuous wave).

b. If the complete system is dead, the trouble is in the power source.

c. Operate the rectifier, if possible. See checklist in the instruction books for Radio Transmitter Model 96D and Rectifier Power Unit Model 36D. Operate a transmitter and observe its performance. Note that if the rectifier has failed, all the transmitters to which it furnishes power will be inoperative. If, however, all the transmitters except the one in question are operative, the rectifier is functioning correctly.

d. Select and key transmitter at remote console. If transmitter keys locally but not at the control console, see equipment performance checklist in the instruction book for Remote Control Console Type CS-212.

e. Operate the modulator, if possible, and observe its performance. See equipment performance checklist (par. 43) for normal operating conditions. Use the local dial to connect the modulator to a transmitter. If keying that transmitter puts the modulator in op-

erating condition, the modulator control functions of the dialing and auxiliary relay unit are operating correctly. If these functions cannot be controlled from the remote operating position, the trouble is isolated to either the remote control console or the lines connecting the control console and the modulator.

f. If only one component is dead, the trouble is in that component and is probably a fuse. Check the fuses at an early stage in trouble shooting. Do not continue to burn out fuses before looking elsewhere to determine the basic source of the trouble.

g. By use of procedures similar to the checks outlines above, the trouble can be isolated to a single unit within the component.

42. Trouble Shooting, using Equipment Performance Checklist (par. 43).

a. General. The equipment performance checklist will help the operator to locate trouble in the equipment. The list gives the item to be checked, the conditions under which the item is checked, the normal indications and tolerances of correct operation, and the corrective measures the operator can take. To use this list, follow the items in numerical sequence.

b. Action or Condition. For some items, the information given in the action or condition column consists of various switch and control settings under which the item is to be checked. For other items, it represents an action that must be taken to check the normal indication given in the normal indication column.

c. Normal Indications. The normal indications listed include the visible and audible signs that the operator should perceive when he checks the items. If the indications are not normal, the operator should apply the recommended corrective measures.

d. Corrective Measures. The corrective measures listed are those the operator can make without turning the equipment in for repairs. A reference in the table to chapter 5 indicates that the trouble cannot be corrected during operation and that trouble shooting by an experienced repairman is necessary. If the set is completely inoperative or if the recommended corrective measures do not yield results, trouble shooting is necessary. However, if the tactical situation requires that communication be maintained and if the equipment is not completely inoperative, the operator must maintain the equipment in operation as long as it is possible to do so.

43. Equipment Performance Checklist

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PREPARATORY	1	Safety panels and doors. (Except outer front door)	Closed and latched.		

43. Equipment Performance Checklist (contd)

	Item No.	Item	Action or condition	Normal indications	Corrective measures
S T A R T	2	Three-phase a-c power switch.	Close.		
	3	Circuit breaker on rectifier.	Close.		
	4	START switch on rectifier or remote control console	Push in.	Blower motor in modulator starts.	Replace BLOWER fuses (F-1 and F-2).
				Filaments light (except V-106 and V-107).	Replace fuses labeled RECT FILA (F-9 and F-10); BIAS (F-3 and F-4). Replace defective tubes.
				MODULATOR BIAS meter reads approximately 220 volts.	Replace BIAS fuses (F-3 and F-4). Adjust bias voltage. See instructions in chapter 2, section I. Replace V-112 and/or V-113.
	5	Transmitter selector switch at remote control console.	Close.		
	6	Modulator line selector switch at console.	Switch to line corresponding to desired modulator.		
	7	Dial at console.	Dial number corresponding to transmitter selected in step 5.	Stepping relay K-201 operates.	Repair console. Repair remote control line. Replace fuse F-4 in Power Rectifier Unit Model 36D. Refer to chapter 5.
	8	Key at console	Close key to turn on transmitter carrier. Do not apply audio signal to modulator input.	Transmitter operating V-106 and V-107 light.	Repair transmitter. Close all interlock switches. Replace 450TL FILA fuses (F-5 and F-6). Replace V-106 and/or V-107. Refer to chapter 5.
				MODULATOR meter reads approximately 80 ma.	Replace V-106 and/or V-107. Check Power Rectifier Unit model 36D for proper operation of high voltage supply. Refer to chapter 5.

43. Equipment Performance Checklist (contd)

	Item No.	Item	Action or condition	Normal indications	Corrective measures
EQUIPMENT PERFORMANCE	9	DRIVER CURRENT switch S-2.	Push switch up.	DRIVER AMP meter reads 45 to 55 ma.	Replace LOW VOLTAGE fuses, (F-7 and F-8) Replace V-104, V-108, V-109, V-110, and V-111.
			Push switch down.	DRIVER AMP meter reads 45 to 55 ma.	Replace V-105.
	10	AUDIO LEVEL switch S-1 and remote control console.	Apply audio signal to modulator line at console and push switch up.	AUDIO LEVEL meter reads up to +3 db depending on audio signal input level.	Repair remote control line.
			Apply audio signal to modulator line at console and push switch down.	AUDIO LEVEL meter reads up to0 db, depending on audio signal input level.	Replace V-101, V-102, and V-103. Refer to chapter 5.
	11	Remote contol console.	Apply audio signal to modulator line at console.	MODULATOR meter reads from 80 ma to 620 ma approximately, depending on audio signal input level.	Refer to chapter 5.
STOP	12	Key at remote control console.	Release.	MODULATOR meter reads 0. Filaments of V-106 and V-107 go off.	Refer to chapter 5.
	13	Transmitter selector switch at remote control console.	Release	Stepping switch K-201 returns to home position.	Refer to chaper 5.
	14	STOP switch on rectifier or console.	Press in.	Blower motor stops. All tube filaments go off.	Refer to chapter 5.

CHAPTER 4

THEORY

SECTION I. MODULATOR TYPE 50H

44. Modulator Type 50H, Block Diagram (fig. 17)

Modulator Type 50H is designed to furnish 1,600 watts of audio power to plate modulate Radio Transmitter Model 96D. The output of the modulator is 1,600 watts of audio power at any frequency between 400 and 3,000 cps with a signal input of anywhere from -20 to +3 db. All of the amplifier components, including their related power supplies, are mounted on one chassis (the amplifier chassis) with the exception of the modulation transformer and the plate power supply for the modulator tubes. The selection relays and control relay are mounted on a separate chassis (the dialing and auxiliary relay unit). A dial mounted on the modulator control panel is used for local control and testing of the equipment. A-f (audio-frequency) signals and dialing tones from a remote control console are supplied to the modulator over the same line. In conjunction with the h-v switching unit in Redtifier Power Unit Model 36D, the relay system functions to connect the modulator to any one of 10 transmitters and either of 2 rectifiers. Figure 17 is a complete block diagram of the modulator.

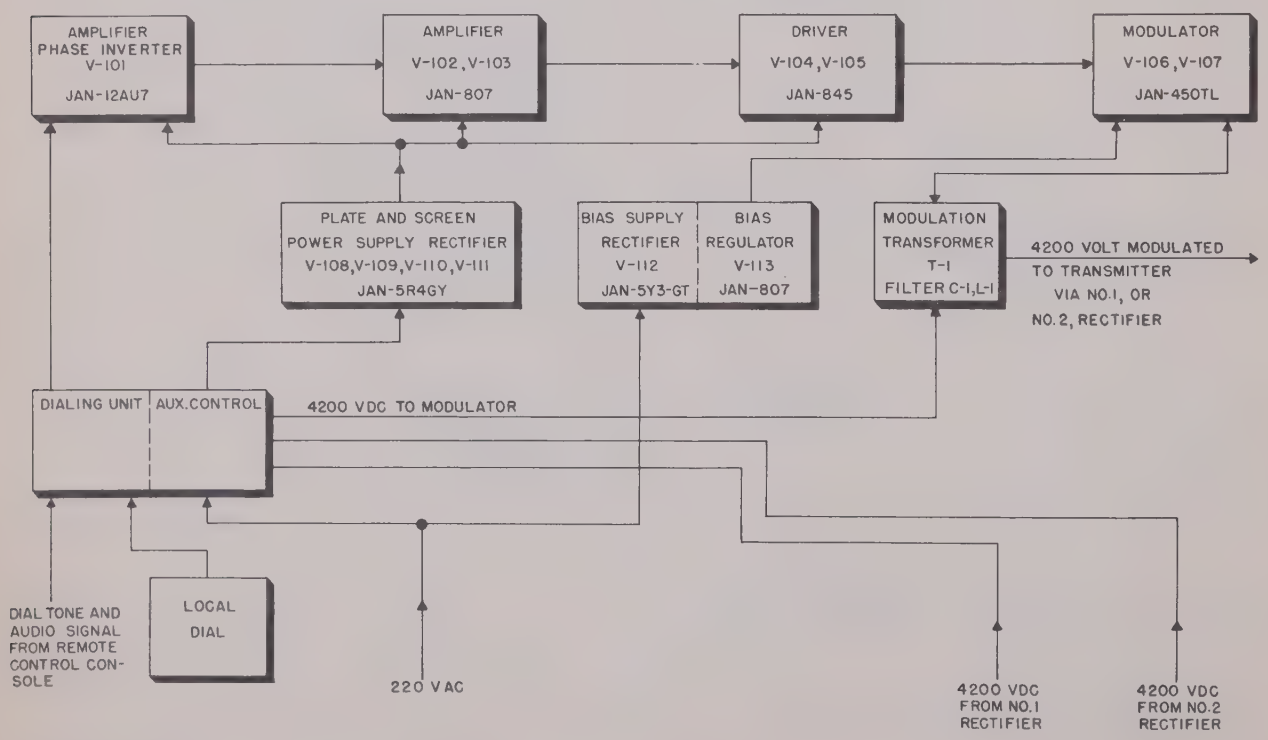

AMPLIFIER PHASE INVERTER V-101 JAN-12AU7
AMPLIFIER V-102,V-103 JAN-807
DRIVER V-104,V-105 JAN-845
MODULATOR V-106,V-107 JAN-450TL
PLATE AND SCREEN POWER SUPPLY RECTIFIER V-108,V-109,V-110,V-111 JAN-5R4GY
BIAS SUPPLY RECTIFIER V-112 JAN-5Y3-GT
BIAS REGULATOR V-113 JAN-807
MODULATION TRANSFORMER T-1 FILTER C-1,L-1
4200 VOLT MODULATED TO TRANSMITTER VIA NO.1, OR NO.2, RECTIFIER
DIALING UNIT
AUX.CONTROL
4200 VDC TO MODULATOR
DIAL TONE AND AUDIO SIGNAL FROM REMOTE CONTROL CONSOLE
LOCAL DIAL
220 VAC
4200 VDC FROM NO.1 RECTIFIER
4200 VDC FROM NO.2 RECTIFIER

Figure 17. Modulator Type 50H, block diagram

a. First Amplifier and Phase Inverter. The audio signal from the remote console is connected to the input side of V-101 through isolating transformer T-201. In the first section of this twin triode the signal is amplified . A portion of this amplified signal is then coupled to the grid of the second section to give an amplified signal inverted in phase so that two signals out of phase can be used to drive the tubes in the following stage.

b. Speech Amplifier. Two tubes, V-102 and V-103, are used as a push-pull speech amplifier to amplify the signal produced by the first amplifier and phase inversion circuit. The output of these tubes is 180° out of phase with each other and is coupled through the d-c blocking capacitors to the input of the driver stage.

c. Driver Stage. The driver stage consists of two tubes, V-104 and V-105, in a class A push-pull circuit. These tubes amplify the output of the predeeding stage and the output of the drivers is coupled by a transformer to the input side of the modulator stage.

d. Modulator Stage. The modulator stage consists of two tubes, V-106 and V-107, operating as a Class B push-pull amplifier. The plate voltage for these tubes is derived from the same supply as the plate voltage for the final amplifier tubes in the transmitter. Because of the action of the modulation transformer T-1, the audio voltage generated by these tubes is impressed on the plate voltage supplied to the final amplifier stage in the transmitter.

e. Plate and Screen Power Supply. The plate and screen power supply, consisting of two transformers and four rectifier tubes, V-108 through V-111, provides the d-c power for the plate and screens of amplifier tubes V-101 through V-105.

f. Bias Supply Rectifier and Regulator. The bias supply rectifier and regulator consists of two tubes, V-112 and V-113, a transformer, and a bias protection relay. Rectifier V-112 provides a negative 220 volts d-c bias for the modulator tubes. The regulator controls this bias so that when the modulator tubes draw current, the bias voltage is held essentially constant. The bias protection relay provides protection for the modulator tubes in case the bias supply fails.

g. Modulation Transformer, Filter Reactor, and Filter Capacitor. The modulation transformer, T-1, modulates the plate supply for the transmitter final amplifier tubes. The filter reactor, L-1, and the filter capacitor, C-1, act as a filter network in the plate-voltage supply for the modulator tubes.

h. Dialing and Auxiliary Relay Unit. The dialing and auxiliary relay unit consists of ten relays mounted on a chassis with a metallic rectifier, an input transformer for the audio signal, a wire-wound resistor, a toggle switch, and two capacitors. This unit interprets the dialing signal pulses, and by means of the relays and a stepping switch, interconnects the modulator, rectifier, and the desired transmitter in conjunction with the h-v switching unit in rectifier.

i. Local Dial. A local dial on the control panel is used to put the dialing and auxiliary relay unit into operation in order to interconnect the modulator and rectifier to a desired transmitter.

45. Self-balancing Phase-Inverter Amplifier (fig. 18)

A type 12AU7 twin triode tube, V-101, is used as a phase inverter and amplifier. The phase inverter circuit is used to provide two outputs from a single phase input. The necessity of a phase inverter arises because the signal voltages supplied to a push-pull stage must be 180° out of phase and approximately equal in amplitude with respect to each other.

a. The balanced input line is terminated in variable grid resistor R-101 (the AUDIO GAIN control). A portion of the

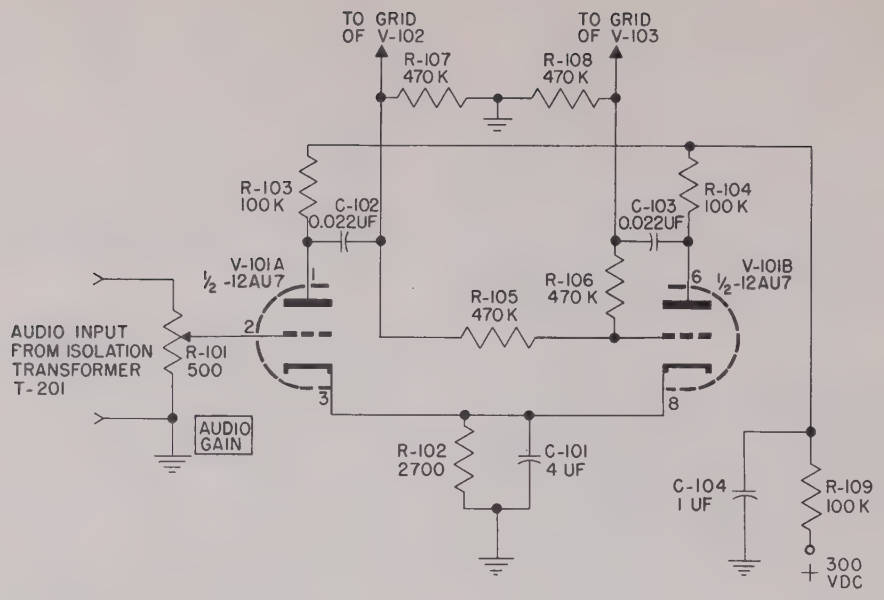


Figure 18. Modulator Type 50H, simplified schematic diagram of self-balancing phase-inverter amplifier stage

audio voltage developed across R-101 is connected directly to the grid of the first section of V-101 (V-101A). The signal is amplified in the tube and the amplified audio voltage is developed across R-103, the plate load. This amplified audio signal, is coupled through capacitor C-102 to the grid of V-102, the following speech amplifier, and to a resistor network consisting of R-105 and R-106, the phase inverter circuit.

b. The grid of the second section of V-101 (V-101B) is connected to the junction of resistors R-105 and R-106, thereby receiving a portion of the amplified audio signal feeding tube V-102. The signal at the plate of V-101B is inverted in phase and thus the output of the two sections will be 180° out of phase with each other. R-104 is the plate load for the second section and C-103 couples the audio signal output of the second section to the grid of V-103. The circuit is self-balancing to a large extent because of the negative feedback from the plate of the second section to its own grid through resistor R-106. The circuit proportions are such that the over-all gain from the plate of the first section to the plate of the second section is nearly unity and is controlled through the negative feedback loop.

c. The cathodes of V-101 are connected to ground through R-102 providing self-bias for the tube. The primary purpose of capacitor C-101 is to bypass to ground hum and noise appearing on the cathode due to its closeness to its own heater. Plate voltage for the stage (150 volts dc), is furnished from the power supply bleeder network. R-109 and C-104 form a filter or decoupling network in the plate power line to filter out hum and possible audio voltages (from other stages) appearing in the bleeder network.

46. Amplifier Stage (fig. 19)

The second amplifier stage uses two type 807 tetrodes, in a push-pull circuit. This stage amplifies the two audio signals produced by the phase inverter amplifier stage.

a. The audio signal from V-101A is coupled by C-102 to the control grid of V-102. The audio signal from V-101B is coupled by C-103 to the control grid of V-103. Resistor R-107 is the grid

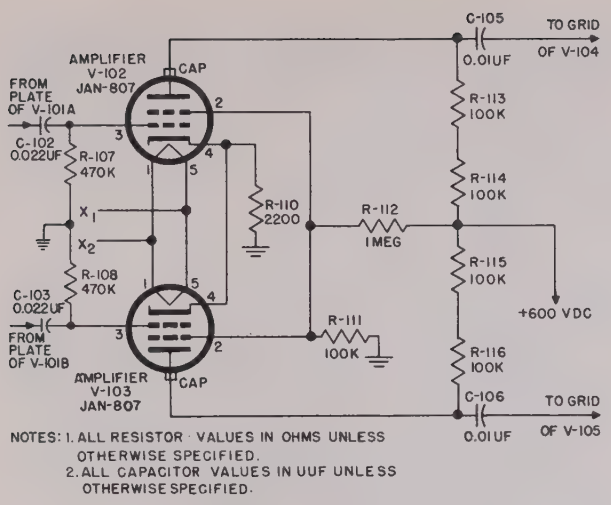


Figure 19. Modulator Type 50H, simplified schematic of amplifier stage

resistor for V-102 and resistor R-108 is the grid resistor for V-103. Plate voltage for V-102 is applied through resistors R-113 and R-114, and the plate voltage for V-103 is applied through R-115 and R-116. The plate load resistors for each tube are in series to provide a higher power dissipation rating than for one resistor alone. Screen voltage for V-102 and V-103 is obtained from a voltage divider consisting of resistors R-112 and R-111. The output of V-102 is coupled to the driver tube V-104 by C-105 while the output of V-103 is coupled to V-105 by C-106.

b. The cathodes of V-102 and V-103 are connected together and to ground through R-110 to provide self-bias. Neither the cathodes nor the screen grids of the tubes are bypassed to ground, thus aiding in obtaining balanced output through the resulting degeneration. Bypassing is not required in this stage since the signal levels at this stage are much larger than any hum and noise voltages which may be present.

47. Driver Stage (fig. 20)

The driver stage uses two type 845 tubes in a push-pull circuit to obtain sufficient power at low distortion to drive the tubes in the modulator stage.

a. The audio signal from V-102 is coupled through C-105 to the grid of V-104. R-117 is the grid resistor for V-104. The audio signal from V-103 is coupled to the grid of V-105 through C-106. R-118 is the grid resistor for V-105.

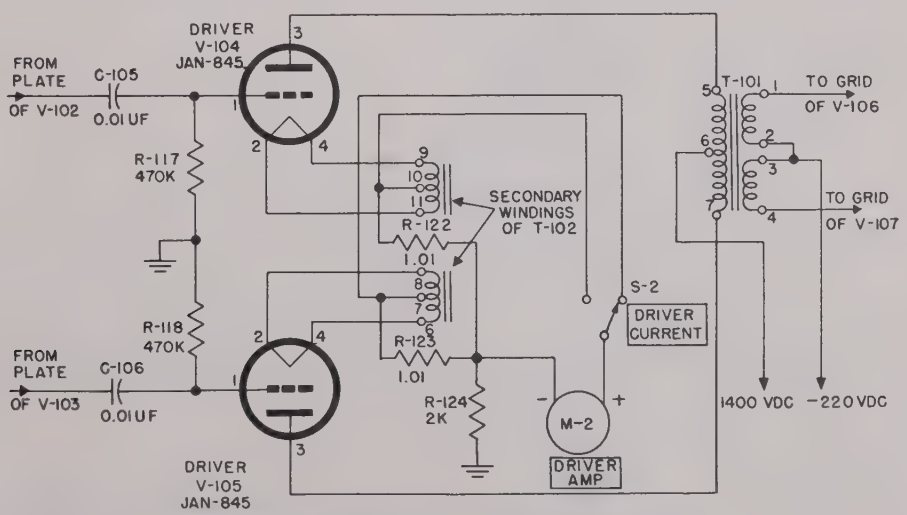


Figure 20. Modulator Type 50H, simplified schematic of driver stage

b. The plates of V-104 and V-105 are connected to the primary of T-101. T-101 is center tapped and this tap is connected to the power supply bleeder 1,400 volts dc tap between L-101 and R-125.

c. The filaments of these two tubes are connected to separate secondary windings on T-102, so that the plate current for each tube can be measured separately by the meter labeled DRIVER AMP, using meter switch S-2, The meter current is obtained from the voltage drop across R-122 or R-123 depending upon the position of the switch. The center taps of the filament windings for tubes V-104 and V-105 are returned through resistors R-122 and R-123 respectively to resistor R-124, Plate current flow through R-124 to ground provides self-bias for V-104 and V-105. Resistor R-124 is not bypassed thus aiding in obtaining balanced output from the circuit.

48. Modulator Stage (fig. 21)

The modulator stage uses two type 450TL tubes, V-106 and V-107, in a Class B push-pull circuit. The output of the driver stage is transformer coupled to the modulator stage and the output of the modulator tubes is used to modulate the plate voltage for the transmitter final amplifier stage.

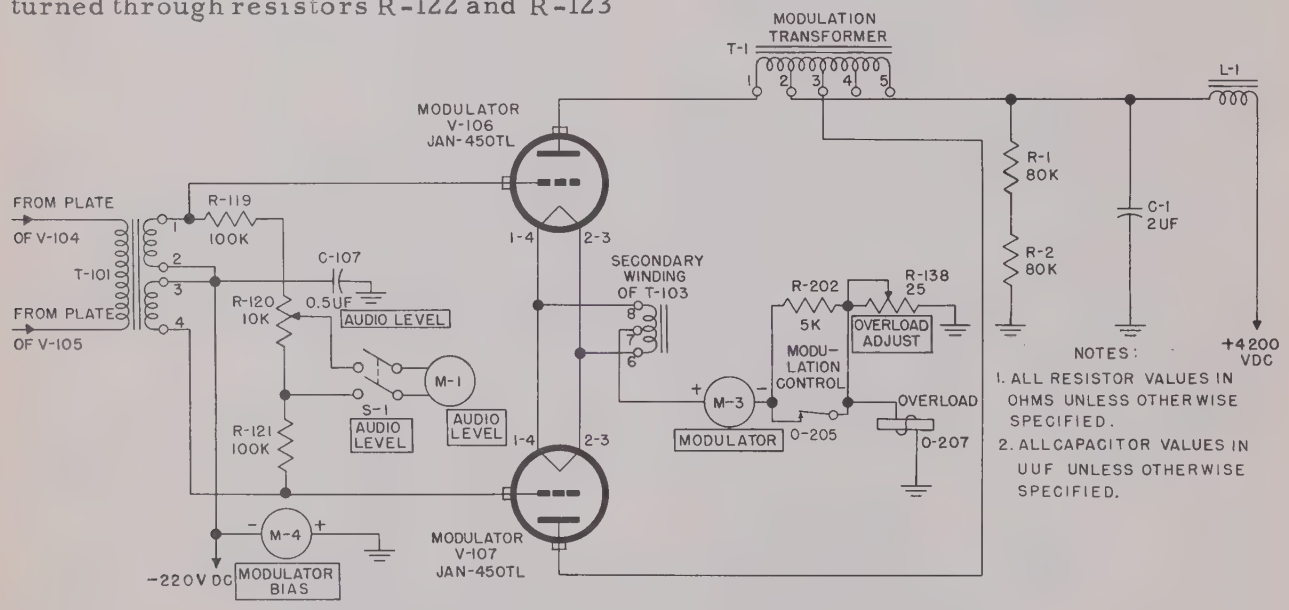


Figure 21. Modulator Type 50H, simplified schematic of modulator stage

a. The signal from the plates of V-104 and V-105 is developed across the primary of driver transformer T-101. The signal voltage for the grids of the modulator tubes is obtained directly from the split secondary winding of the transformer. To develop full modulator output, the grids of V-106 and V-107 must be driven positive, requiring a considerable amount of power. To maintain low distortion, the signal voltage regulation at the grids must be good. Adequate regulation and power is obtained by use of a step-down voltage ratio of approximately two to one between the primary and secondary of T-101. The center tap of the transformer secondary is bypassed to ground through C-107, providing a low-impedance ground return for the a-c components of grid current.

b. A voltage divider network consisting of R-119, R-120, and R-121 provides a means of metering the output of the driver stage. The voltage developed between the movable tap of R-120 (AUDIO LEVEL control) and the junction of

R-120 and R-121 is applied to AUDIO LEVEL meter M-1 when AUDIO LEVEL switch S-1 is the OUTPUT position. Normally R-120 is adjusted to give a reading of 0 db on meter M-1 when the modulator is developing full output. This provides a method of conveniently checking the performance of the amplifier up to the grids of the modulator tubes.

c. Plate voltage for the modulator tubes is furnished through the modulation transformer, T-1, (terminal 2) from the Rectifier Power Unit Model 36D. A filter network consisting of L-1 and C-1 reduces the residual hum in the h-v supply from the rectifier to a negligible value. This filter also serves to isolate the unmodulated high voltage from the modulated high voltage when both modulated and unmodulated transmitters are supplied simultaneously from the same rectifer. R-1 and R-2 (in series) are bleeder resistors that act to discharge C-1 after the modulator has been shut down. This lessens danger of h-v shock to maintenance personnel. T-1 is an autotransformer designed to properly match the plate circuit of the modulator tubes to the load presented by the plate circuit of the final amplifier tubes in the transmitter. Terminals 1 and 3 are connected to the plates of the modulator tubes. Terminal 4 or 5 furnishes the output modulated 4,200 volts for the final amplifier plate circuit of the transmitter being modulated. Terminal 4 (4,500 ohms impedance) is used to modulate Radio Transmitter Model 96D operating at full output. Terminal 5 (7,500 ohms impedance) may be used to modulate the transmitter operating at reduced output. The impedance presented by the transmitter is calculated by dividing the d-c plate voltage (in volts) applied to the modulated stage (in the transmitter) by the total plate current (in amperes) drawn by the tubes in the modulated stage. The modulator tubes are biased nearly to cut-off as required in a Class B audio amplifier. One tube supplies nearly all the power on one half the audio cycle while the other tube supplies nearly all the power on the other half-cycle. The push-pull connections of the plates to the modulation transformer results in proper adding of the outputs of the two tubes to produce a complete cycle with low distortion.

d. The filaments of V-106 and V-107 are connected in parallel and supplied from the secondary winding of filament transformer T-103. The center tap of this winding is connected to ground, when the modulator is operating, through MODULATOR meter M-3, a pair of contacts on relay O-205, and the coil of relay O-207 and variable resistor R-138 in parallel. Thus meter M-3 reads the total grid and plate currents of both modulator tubes. Since the tubes are biased nearly to cut-off, the total current will increase as the grid voltage and therefore, the power output of the tubes increases. MODULATOR meter M-3 furnishes a convenient indication of the modulator power output and condition of the modulator tubes. When the modulator is not operating, the contacts of relay O-205 are open and resistor R-202 (5,000 ohms) is in series with the ground return circuit of the filaments. This results in an immediate large decrease of the amplification abilities of the modulator tubes when the modulator is turned off, during the time the filaments are cooling, thus reducing the possibility of switching surges causing excessive voltages across the modulator transformer. R-138, the OVERLOAD ADJUST resistor, is used to adjust the amount of current required to operate the overload relay O-207.

e. Bias voltage -220 volts dc is applied to the grids of V-106 and V-107 from the bias rectifier and regulator circuit through a connection to the center tap on the secondary winding of T-101. Meter M-4 (MODULATOR BIAS) is connected across this bias supply to ground and provides a visual indication of the bias voltage applied to the grids.

49. Plate and Screen Power Supply (fig. 22)

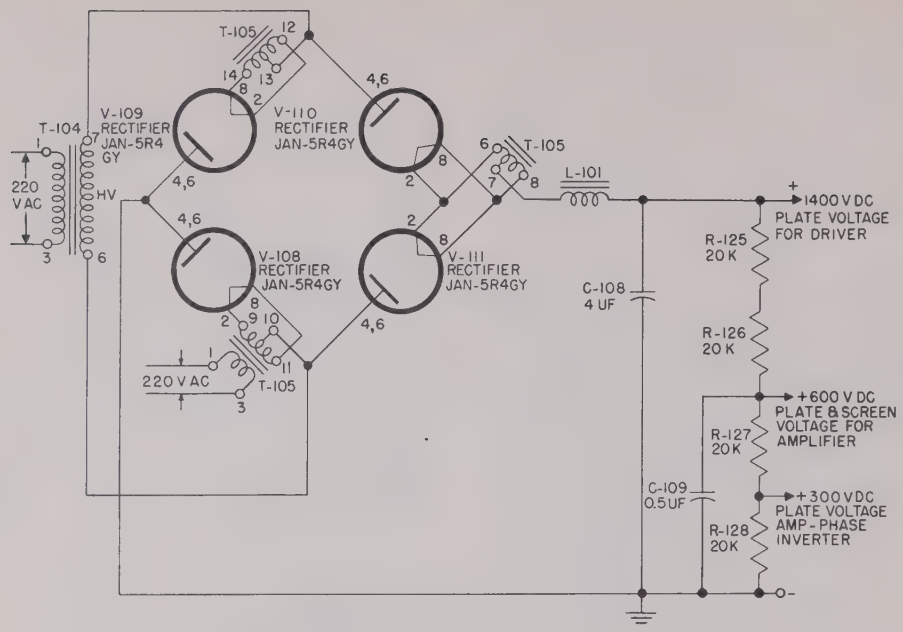


Figure 22. Modulator Type 50H, simplified schematic of plate and screen power supply

Four type 5R4GY tubes are used in a full-wave bridge rectifier.

a. Transformer T-104 furnishes the high voltage, and transformer T-105 furnishes the filament voltage for the rectifier tubes. The filaments of V-110 and V-111 are connected in parallel to one secondary winding of T-105. The filaments of V-108 and V-109 are connected to the other two secondaries of T-105 respectively. The a-c voltage developed across the secondary of T-104 is rectified as follows: When the upper end of the secondary of T-104 is positive, the plates of V-110 and V-108 are positive with respect to their filament. Current flows from the lower end of the secondary of T-104 (which is negative) through T-105 and the filament of V-108, and to the grounded plates of V-108. The current returns from ground through the load circuit, through the filter reactor L-101, through T-105 and filament of V-110, to the plates of V-110. On the other half-cycle of supply voltage (when the lower end of the h-v transformer is positive and the upper end negative), current flows from the upper end of T-104 through T-105 and filament of V-109, and to the grounded plates of V-109. The current returns from ground through the load circuit, through L-101 and filament of V-111, to the plates of V-111 which are connected to the lower end of T-104. Regardless of the polarity of the transformer winding the current through the load is in the same direction.

b. The rectified output is smoothed by filter reactor L-101 and capacitor C-108 to an acceptably low value for supplying plate voltage to driver tubes V-104 and V-105. A choke input filter is used to prevent excessive peak currents through the rectifier tubes. The full output of the filtered rectifier (1400 volts dc) is obtained at the junction of L-101 and C-108 to supply V-104 and V-105. A voltage divider consisting of R-125, R-126, R-127, and R-128 is connected between this same junction and ground. The plate and screen supply voltage for V-102 and V-103 (600 volts dc) is provided at the junction between R-126 and R-127. Capacitor C-109 (with resistors R-125 and R-126) further filters the supply voltage, This is necessary since any hum present at the

plates of V-102 and V-103 will be amplified by V-104 and V-105. Plate supply voltage for V-101 (300 volts dc) is obtained at the junction between R-127 and R-128. C-108 and C-109, also function to reduce to a negligibly small amount the inherent feedback between stages caused by the common power supply.

50. Bias Supply Rectifier and Regulator (fig. 23)

The bias supply rectifier provides a negative d-c bias for the modulator stage only. The regulator holds the bias voltage at a nearly constant amplitude so that changes in grid drive have little affect on the bias voltage. In this circuit, two tubes, V-112 (type 5Y3GT) and V-113, (type 807) are used. T-106 supplies filament and plate voltages for the bias supply rectifier and regulator tubes. Included in this circuit is a relay, BIAS PROTECTION which provides protection to the modulator stage in case the bias supply fails.

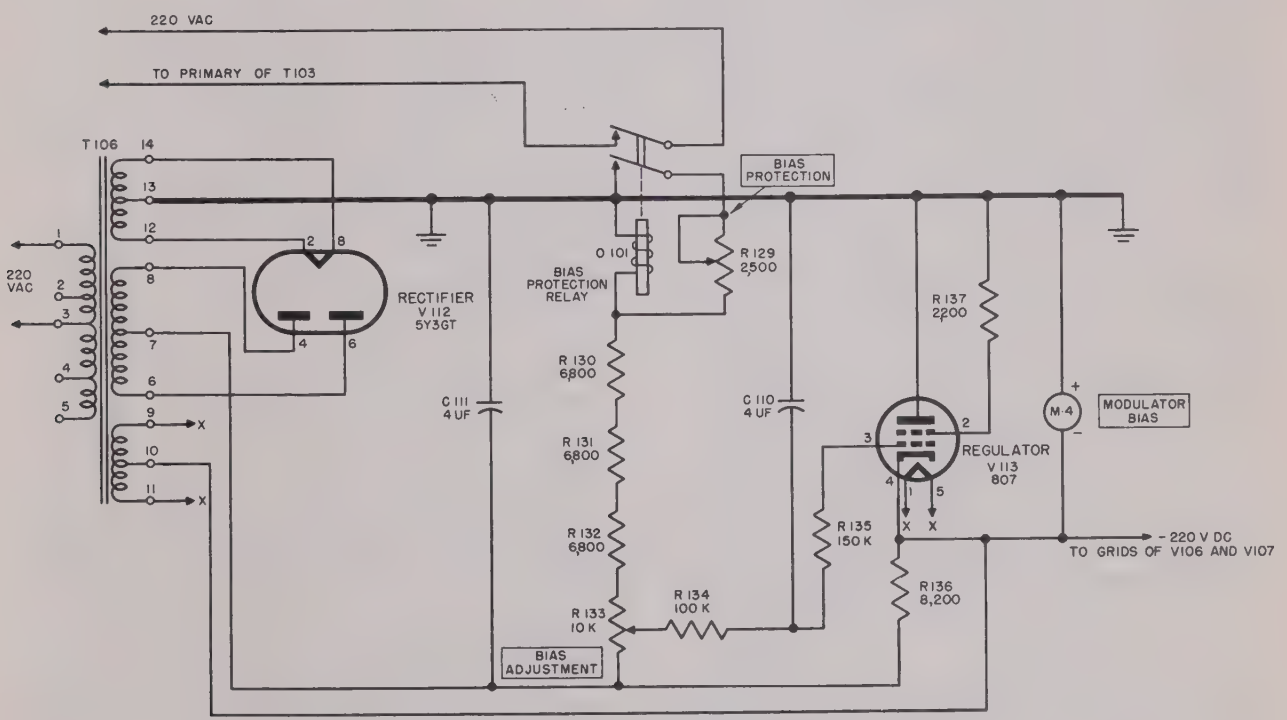


Figure 23. Modulator Type 50H, simplified schematic of bias supply rectifier and regulator

a. V-112 is connected as a full-wave rectifier. Transformer T-106 supplies plate and filament voltage for this tube as well as filament voltage for V-113, the bias regulator tube. The positive side of the output (center tap of the filament winding of V-112) is grounded. The unregulated negative end of the output is taken from the center tap of the plate winding of T-106. C-111 provides adequate filtering of the negative rectified output since little current is drawn from the rectifier. The major portion of the load consists of resistors R-130, R-131, R-132, and R-133 in series with the coil of bias protection relay 0-101.

b. With normal output voltage from the bias rectifier, the current through the coil of 0-101 is adequate to operate the relay. One pair of contacts of the relay is in series with the primary of

T-103, the filament transformer for the modulator tubes. Therefore, failure of the bias supply will cause O-101 to release and consequently remove power from the filaments of the modulator tubes. Thus the modulators are portected from damage in case plate voltage is applied to them with inadequate bias voltage present. Variable resistor R-129, BIAS PROTECTION, is connected in series with the other pair of contacts of O-101 and is paralleled with the relay coil only when the relay is operated. When the bias supply is turned on and before relay O-101 has time to operate, the full current through R-130, R-131, R-132, and R-133 flows through the relay coil, resulting in sufficient magnetic pull to start the relay armature moving. The relay is adjusted so that the contacts do not close until the relay armature has nearly completed its travel, at which time less current is required to complete the operation. Thus, when the relay is nearly completely operated resistor R-129 is paralleled with the relay coil and reduces the coil current. With R-129 properly adjusted the reduced coil current is sufficient to cause the relay to complete its operation but is insufficient to hold the relay if the bias supply voltage falls appreciably. R-129 should be adjusted so that the relay releases when the bias voltage falls to about 70 percent of normal value.

c. The plate of V-113 is connected directly to ground while the screen grid is connected to ground through R-137. R-137 functions as a parasitic suppressor to prevent self-oscillation of the tube. Variable resistor R-133, labeled BIAS ADJUSTMENT, determines the d-c voltage applied to the grid of V-113. The voltage derived from R-113 is filtered by resistors R-134 and R-135, capacitor C-110, and the tube input capacity and is then applied to the grid of the bias regulator V-113.

d. The cathode of the bias regulator is returned to the negative output or center tap of the transformer T-106 bias regulator filament winding through resistor R-136. Thus current flows from the plate and screen of V-113 to the cathode and to the center tap through R-136, developing a voltage at the cathode which is positive with respect to the junction of R-136, R-133, and C-111. The voltage across R-136 is greater than the voltage between the above junction point and the variable tap on R-133, therefore, the cathode of V-113 is positive with respect to its grid. In other words, the grid of V-113 is negative with respect to its cathode. The source of bias voltage for the modulator tubes is the cathode of the bias regulator tube, and is adjustable within certain limits by changing the setting of the tap on R-133. Since the adjustment of R-133 determines the d-c grid voltage applied to V-113, the plate and screen current will be controlled. Therefore, the cathode potential, which is the grid bias applied to the modulator tubes, will also be controlled. When the modulator tube grids are driven positive, as they are when large audio signals are applied, the tendency is to make the cathode of V-113 more negative, because of the rectifying action of the modulator tube grids. This is equivalent to making the grid of V-113 more positive, which increases the plate and screen current, making the cathode voltage more positive. This action is similar to that taking place in a cathode follower circuit. The two opposing forces, cancel to a large degree and hold the grid bias voltage applied to the modulator tubes relatively constant, regardless of the signal voltage applied.

51. Dialing and Auxiliary Relay Unit (fig. 24, 25, 26 and 27)

The dialing and auxiliary relay unit provides facilities for remotely selecting any one of 10 transmitters for amplitude modulated operation. Also included in this unit are the auxiliary control relays for operation of the modulator. These relays consist of the overload, blower interlock, modulator control, and rectifier selector relays. Because of the complexity of the circuits involved

in the dialing system and the auxiliary control circuits, discussion is presented in three paragraphs. Paragraph 52 explains the operation of the pulse relay (O-201), transfer relay (O-202), function relay (O-203), homing relay (0-204), and the stepping relay (K-201). Paragraph 53 explains the operation of the modulator control Relay (O-205), blower interlock relay (O-206), overload relay (O-207), and the rectifier selector relays (O-208 and O-209). Paragraph 54 explains the two systems of applying the dialing voltage to the dialing and auxiliary relay unit.

52. Dialing System

To start the operation of the dialing system, a transmitter channel switch (at the remote control console) is closed. This causes the selected transmitter to go into stand-by condition, removing the -12 volts dc from the transmitter modulator release terminal. The 12-volt d-c power used for operation of the relays is supplied by the rectifier power unit.

Note. In the simplified schematic diagrams of the dialing system (figs. 24, 25, 26, and 27), reference is made to the individual relay contacts by letter and to the moving arm of relays by a number. This is to aid in following the system functioning.

a. A number, corresponding to the transmitter selected for operation, is dialed at the remote control point sending a series of a-c pulses at a rate of about 10 per second to the primary of transformer T-201 or to the center tap of the primary of T-201 and ground, depending on the system (parallel or simplex) of dialing used. Each pulse, with the exception of the first, is approximately 1/20 of a second long and is composed of 60 cps alternations of a voltage, between 10 and 60 volts, depending on the attenuation of the line connecting the control position to the modulator. The length of the first pulse depends on the time taken by the operator to pull the dial around to the finger stop and release it. The a-c pulses applied to the metallic rectifier CR-201 are rectified and then operate the d-c relay O-201, causing it to close once with each pulse. This circuit is shown in heavy lines in figure 24. The arm (1) of O-201 is connected to the negative side of the 12-volt d-c supply. It should be noted at this point that one end of the actuating coils of O-202, O-203, O-204, and K-201 are connected to the positive side of the 12-volt d-c supply. When O-201 closes, a negative potential is connected to the arm (9) of the double-throw contact mechanism of the off-normal switch of K-201. Thus, the circuit for the coil of O-202 is completed through contact A of K-201 causing O-202 to close. The broken line in figure 24 shows these circuits completed by closing of O-201. Relay O-202 is a slow release relay so adjusted that it will remain closed during a series of pulses.

b. When O-202 closes, negative 12 volts is applied, through arm 8 and contact A of O-204 and arm 2 and contact B of O-202, to the coil of O-203 causing it to close. This circuit is shown in figure 25 by a heavy line. Upon operation of O-203, negative 12-volt pulses are applied to the coil of stepping relay K-201 through the contacts of O-201, through arm 4 and contact B of O-203, and contact C and arm 7 of O-204. Thus for each pulse of the dial, K-201 is operated once. Each time K-201 is energized, it pushes the drive arm of the stepping relay against a leaf spring or pawl which is drawn across one tooth of a ratchet, and upon release the tension of the spring advances the ganged wiper arms to the next position. Capacitor C-201 in series with resistor R-201 comprise a spark filter or suppressor to absorb the fairly large amount of energy stored in the magnetic circuit of K-201. This protects the contacts of pulsing relay O-201 from excessive arcing. As the stepping relay advances, the off-normal cam on the stepping relay releases the arm 9 to make connection with contact B. O-202 will now stay energized through contact A, arm 3 of

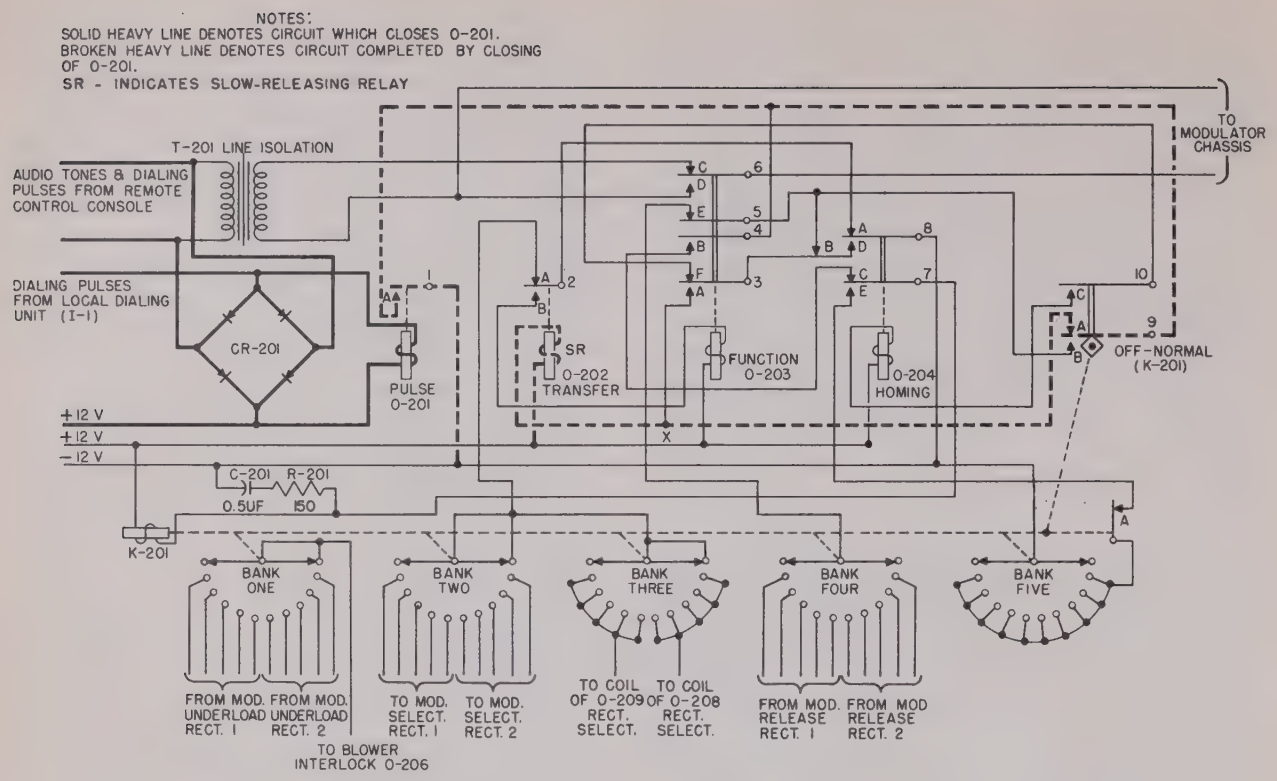


Figure 24. Modulator Type 50H, simplified schematic of first and second operational sequence of dialing system

O-203, through contact B of O-204, through contact B and arm 9 of K-201 off-normal switch, and the contacts of O-201. In this manner the stepping relay wiper arms will advance to the contact number corresponding to the number dialed (number of pulses) at the remote control position.

c. Upon completion of the series of dialing pulses, relay O-201 ceases to operate, stepping relay K-201 stops, and relays O-202 and O-203 are de-energized. Negative 12 volts is connected through arm 8 and contact A of O-204 to arm 2 and contact A of O-202 and then to the wiper arms of banks two and three of the stepping relay. The contacts of bank two are connected through the modulator terminal board to relays in the h-v switching unit in the rectifier power units. Figure 26 shows the circuits involved in this sequence with a heavy line. The first five contacts of bank three are connected to rectifier selector relay O-209 and the second group of five contacts of bank three are connected to rectifier selector realy O-208. Thus if numbers 1 through 5 are dialed, the modulator high voltage will be obtained from rectifier No. 1. If numbers 6 through 10 are dialed, the modulator high voltage will be obtained from rectifier No. 2.

d. To release the relay circuits described above so that modulator may be switched to another transmitter, the transmitter selector switch at the remote control position is released. This turns off the transmitter and through a relay contact therein, places a negative 12 volts on the contact of bank four of the stepping switch on which the wiper arm has stopped. The negative voltage is connected through contact E and arm 5 of O-203 to contact B of O-204 and then to arm 3, contact F of O-203. Contact F of O-203 is connected to arm 10 and contact C of the off-normal switch which is now closed and then to the coil of O-204. Thus O-204 is energized and

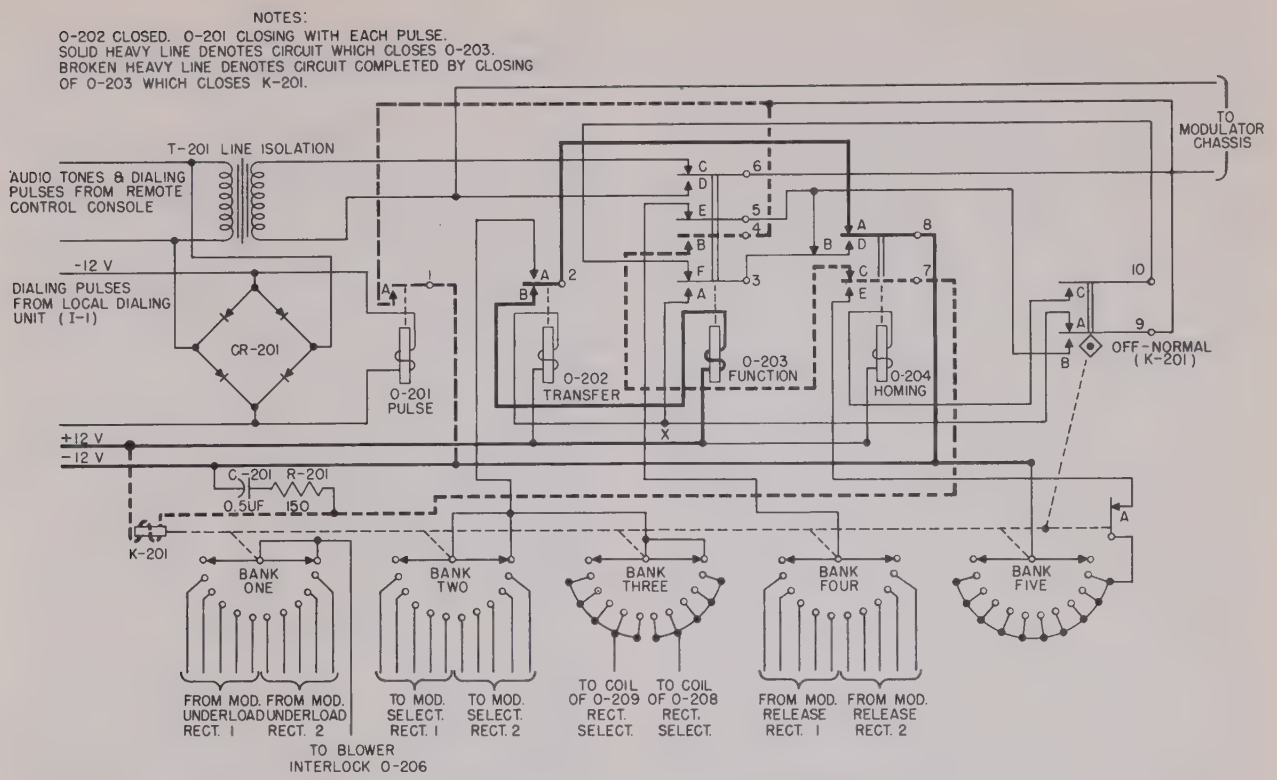


Figure 25. Modulator Type 50H, simplified schematic of third and fourth operational sequences in dialing system

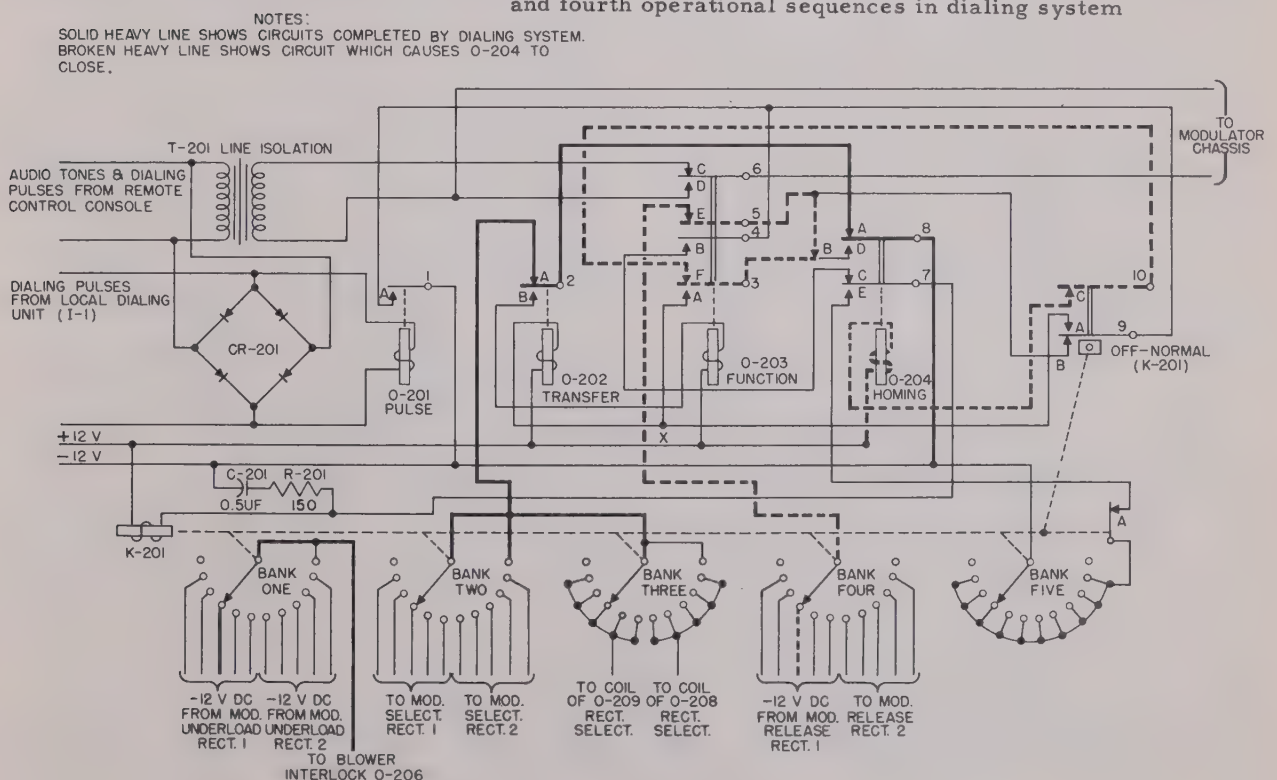

NOTES:
SOLID HEAVY LINE SHOWS CIRCUITS COMPLETED BY DIALING SYSTEM.
BROKEN HEAVY LINE SHOWS CIRCUIT WHICH CAUSES 0-204 TO CLOSE.
T-201 LINE ISOLATION
AUDIO TONES & DIALING PULSES FROM REMOTE CONTROL CONSOLE
DIALING PULSES FROM LOCAL DIALING UNIT (I-1)
CR-201
0-201 PULSE
0-202 TRANSFER
0-203 FUNCTION
0-204 HOMING
TO MODULATOR CHASSIS
OFF-NORMAL (K-201)
+12 V
-12 V
C-201 0.5UF
R-201 150
K-201
BANK ONE
BANK TWO
BANK THREE
BANK FOUR
BANK FIVE
-12 V DC FROM MOD. UNDERLOAD RECT. 1
-12 V DC FROM MOD. UNDERLOAD RECT. 2
TO MOD. SELECT. RECT. 1
TO MOD. SELECT. RECT. 2
TO COIL OF 0-209 RECT. SELECT.
TO COIL OF 0-208 RECT. SELECT.
-12 V DC FROM MOD. RELEASE RECT. 1
TO MOD. RELEASE RECT. 2
TO BLOWER INTERLOCK 0-206

Figure 26. Modulator Type 50H, simplified schematic of fifth and sixth operational sequences in dialing system

circuit is shown with a broken line in figure 26.

e. Relay O-204 is held closed once it is energized by the following circuit: the negative 12 volts is supplied to arm 8, contact D of O-204 and through arm 3, contact F of O-203 to arm 10, contact C of the off-normal switch and to the coil of O-204. This keeps O-204 closed as shown in figure 27 by the heavy line. The wiper arm of bank five is connected to the negative 12-volt supply and this voltage is applied to the interrupter spring contacts when the wiper arm contacts any one of the parallel - connected contacts of bank five. Contact A of the interrupter spring is connected through the now closed contact E and arm 7 of O-204 to the coil of K-201. As soon as K-201 is energized, the drive arm is activated, opening the interrupter contacts and the circuit to K-201. Relay K-201 will now release, advancing the wiper arm to the next position, closing the interrupter spring which again completes the circuit to K-201. As a result of this interrupter spring action, K-201 is supplied by a pulsed voltage causing the wiper arms to move one position for each pulse until the arm of bank five arrives at an unconnected contact. This unconnected point is referred to as a home position. When the stepping relay arrives at a home position, contact C of the off-normal switch opens and breaks the coil circuit of O-204 allowing it to release. Home positions are contacts 1, 14, and 27. Since wiper arms are double-ended, the position of the wiper arm on the last contact (27) is the same as the first contact (figs. 24 and 25). This homing sequence is shown in figure 27 by a broken line. All relays are now released and the dialing system is ready for another dialing operation.

On the stepping relay, contacts 2 and 15, 3 and 16, 4 and 17, etc. are connected together effectively paralleling the halves of the switch so that the most the stepping switch must travel to reach a home po-

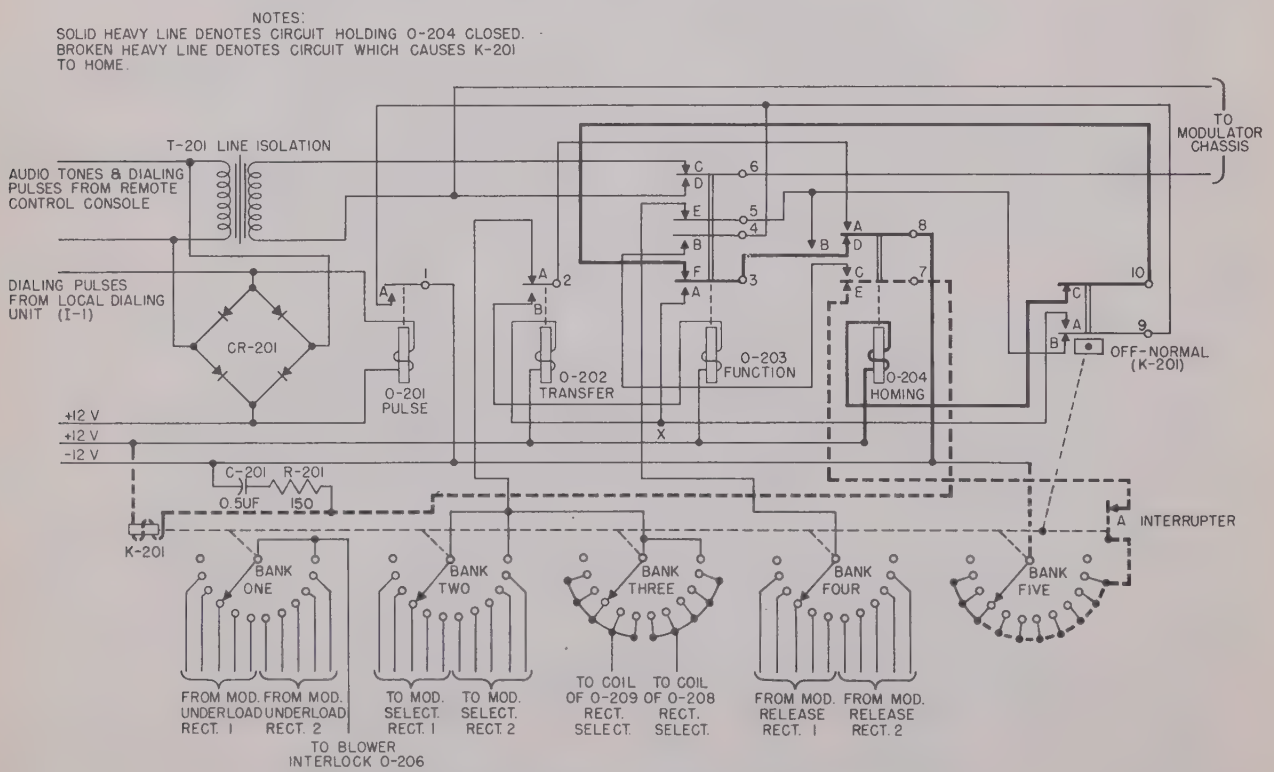


Figure 27. Modulator Type 50H, simplified schematic of seventh and eighth operational sequences in dialing system

sition is 90°. For clarity, the simplified schematics do not show the second group of contacts.

f. In the event a number is dialed and then, without restoring the dialing system to normal by releasing the transmitter selector switch, another number is dialed, the following sequence of operation takes place: relay O-201 is actuated on the first pulse, closing contact A. The negative 12 volts appearing on contact A of O-201 is connected through contact B of the off-normal switch to contact B of O-204. From this point, the sequence of operation is the same as that described when a negative voltage is applied to a selected contact of bank four on the stepping switch. However, the first pulse of the new dial sequence must not cease until after the wiping arms of the stepping relay reach a home position. Otherwise, the first dial pulse will not advance the relay to the first position beyond home. The possibility of faulty operation from this cause is remote for several reasons. First is that normal operation homes the relay by releasing the transmitter selector switch. Second is that in most cases redialing will be done by the operator after realizing a mistake has been made in the number selected. If the wrong number has been dialed and transmitter corresponding to that number was not in use, the stepping relay will immediately home itself identically as it does when the transmitter selector switch is released. Third is that the inherently long first dial pulse in combination with the very rapid homing of the relay makes it difficult to operate the dial rapidly enough to cause faulty operation (par. 52a). Thus proper operation is obtained even though the stepping switch is off the home position upon arrival of the first dialing pulse.

g. Relay O-202 remains closed during the complete dialing operation (keeping O-203 closed). Therefore, contact C of O-203 is open, effectively eliminating any output from the secondary of T-201. Thus, after the very short time required to operate O-202, none of the dialing pulses will be fed to the amplifier chassis. Any dialing pulses getting into the input of the amplifier will be prevented from causing extensive harm by the spark gap across the modulation transformer.

Note. Under no circumstances is the transmitter selected and keyed before dialing the modulator. Always select the desired transmitter, dial the modulator and then key the transmitter. If this is not done, severe damage may result because of the high modulator surge currents. The dialing pulses of approximately 60 volts, 60 cycle, in parallel operation of the dialing line, are in parallel with the speech line to the modulator which normally carries an input speech signal of about 1.5 volts. The amplifier and driver stages may amplify these 60-volt pulses and feed them to the grids of the modulator tubes, which during dialing, are normally cut off due to the protective cathode bias resistor R-202 inserted in the filament center tap. But if the carrier is on, the underload relay in the transmitter functions to apply the negative 12 volts to bank one of the stepping switch. Thus, the protective resistor R-202 is shorted out and the modulator remains operative for the short interval of time until relay O-203 opens the input to the amplifier phase inverter. The spark gap across the modulation transformer only offers partial protection to that part of the circuit.

h. When using the local dial, the operation of the dialing system is nearly the same. The only difference is that the local dial applies d-c pulses directly across the coil of O-201 while the remote dial applied a-c pulses across the metallic rectifier CR-201. The rectifier changes the a-c pulses to d-c pulses which are then applied across the coil of O-201. Figure 28 is a schematic diagram of the local dial circuit. As the local dial is rotated to any given number, the normally closed contact C remains closed and the normally open contacts A and B close. Thus one pulse is generated and contacts A and B are connected to the 12-volt d-c supply in

the rectifier. When the dial is released and allowed to rotate to its normal position, contact C opens and closes a number of times one less than the number dialed. Thus, if the number nine then is dialed, contact C will open and close eight times giving a total of nine pulses including the pulse generated by the initial retation of the dial. The resulting d-c pulses are applied to the coil of O-201.

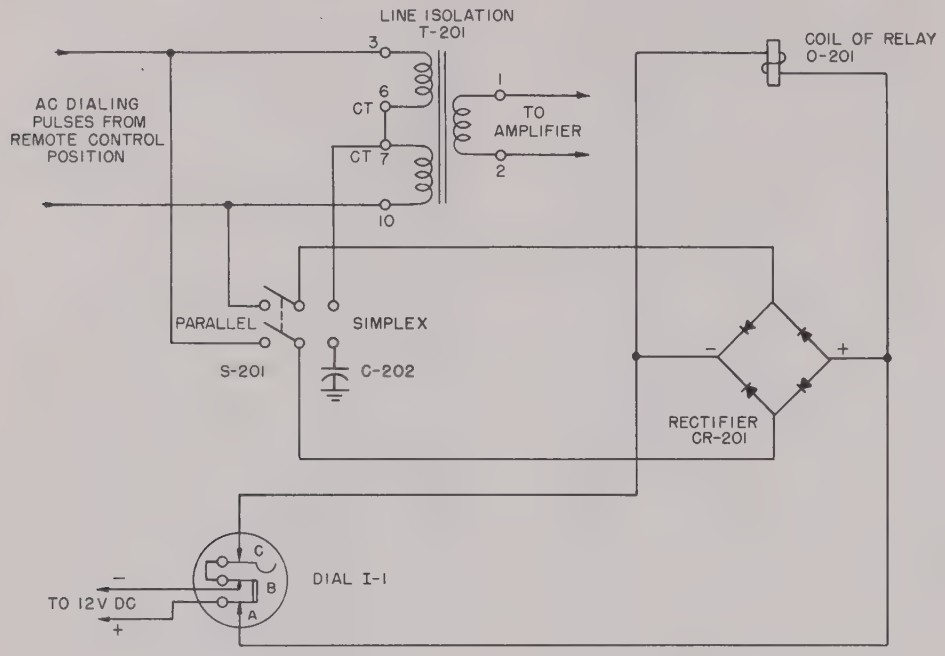


Figure 28. Modulator Type 50H, simplified schematic of local dial circuit

53. Auxiliary Control Circuits (fig. 29)

One side of the coils of relays O-205, O-208, and O-209 are connected to the positive side of the 12-volt d-c supply. The coil of relay O-206, (blower interlock), is across the 220-volt a-c line, and O-207, the overload relay, is in the cathode circuit of the modulator tubes. These five relays are for modulator control and protection.

a. When 220-volt a-c power is applied to the modulator, the blower will start and relay O-206 will close. If the blower does not operate because of a blown fuse, either F-1 or F-2, relay O-206 will not close since it is parallel-connected with the blower.

b. When a transmitter is selected and keyed, negative 12 volts is applied to a contact corresponding to the number of the transmitter on bank one of the stepping switch. If it is desired to modulate the transmitter, the corresponding number will be dialed and therefore the wiper arms of the stepping relay will be resting on the corresponding contact number of each bank. The wiper arm of bank one will complete the negative 12-volt circuit to the coil of O-205 through the contacts of O-206 closing relay O-205. This completes the 220-volt a-c circuit to the primary windings of T-103, the filament transformer for the modulator tubes, and T-104, the plate and screen power transformer. Also contact C of O-205 when closed, shorts out the modulator tubes protective cathode bias resistor R-202. The modulator is now in a completely operative condition.

c. The overload relay, O-207, is in the cathode circuit of the modulator tubes. The amount of current flowing through the coil of O-207 is determined by the position of OVERLOAD ADJUST-

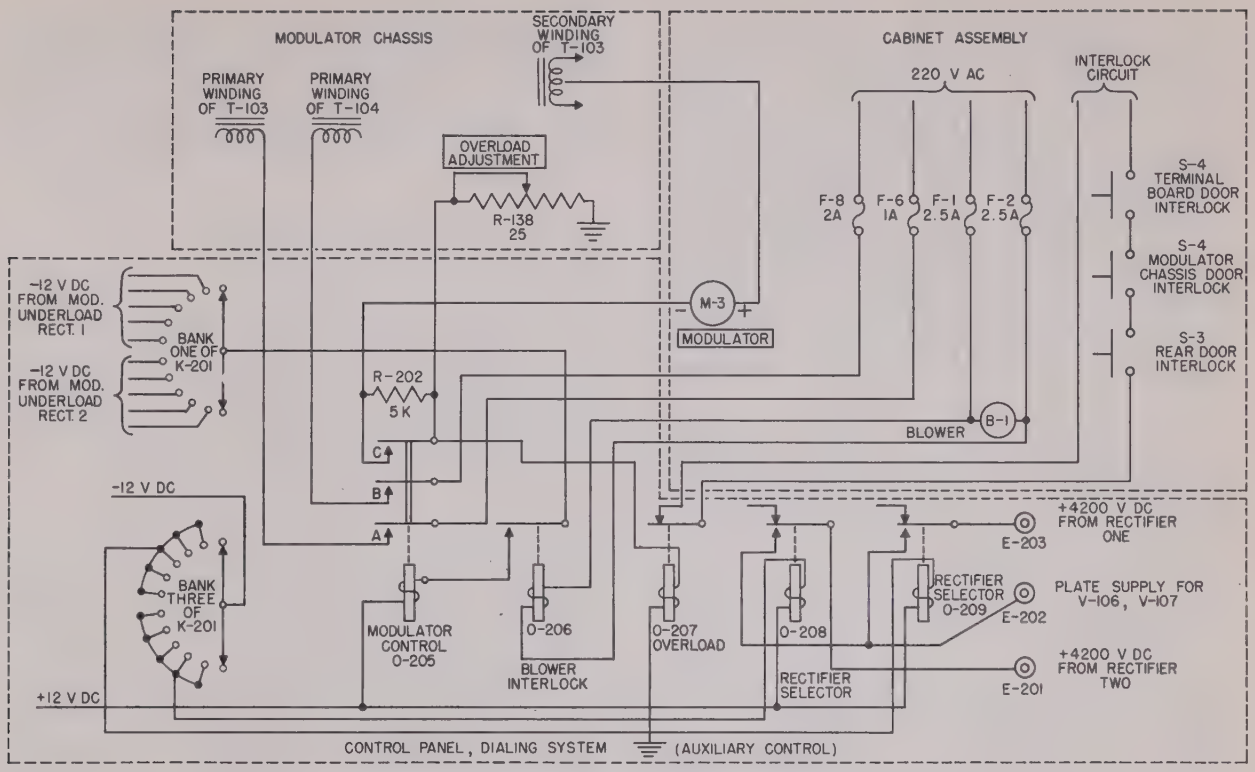


Figure 29. Modulator Type 50H, simplified schematic of auxiliary control circuits

MENT control, R-138. When the modulator tubes draw enough current to cause O-207 to open its contacts, the interlock circuit is broken. This disables the h-v and l-v plate supplies in the rectifier and so removes the plate voltage from the modulator tubes. O-207 is self-resetting so that if the overload is removed, the modulator will be made operative with negligible delay. If the overload is not removed, the plate supplies in the rectifier will be alternately turned off and on at a rate of several times a second.

d. Paragraph 52 shows how negative 12 volts is connected to the wiper arm of bank three on the stepping switch. Note that the contacts of bank three are connected together in groups of five. Thus, if the wiper arm is moved to any contact from one to five, relay O-209 is energized and closes. If the wiper arm is moved to any contact from 6 to 10, O-208 is energized and closes. Closing of O-208 connects one rectifier to the plate circuit of the modulator tubes, while O-209 connects a second rectifier, if one is used, to the plate circuit of the modulator tubes, The contacts of relays O-208 and O-209 are h-v vacuum switches, operating at approximately 4,200 volts dc.

54. Dialing Line System

Either parallel or simplex types of dialing lines may be used with Modulator Type 50H as determined by the position of SIMPLEX-PARALLEL switch S-201. PARALLEL dialing uses two wires of the audio line to transmit the dialing pulses. SIMPLEX dialing uses the two wires of the audio line as one side of the closed circuit, and ground as the other side. S-201 must be switched to the position corresponding to the type of dialing used. The two positions are clearly marked on the dialing and auxiliary relay unit. A lock is provided to secure the switch handle against accidental operation. Capacitor C-202 prevents grounding the negative 12 volts through rectifier CR-201 when the switch is in SIMPLEX position and the local dial is used. The dialing and auxiliary relay unit operates in the same manner with either type of dialing system.

55. System Functioning

Modulator Type 50H is a component of a large fixed-station installation that may consist of 1 to 10 transmitters, 1 to 4 rectifiers, 1 to 4 modulators, and 1 to 6 remote control units. Figure 3 is a block diagram of a complete installation.

a. General Theory of System Operation. The operation of the equipment is controlled from a remote control unit such as Remote Control Console (Wilcox Electric Type CS-212). The operator at the remote control unit has the choice of any one of the transmitters that is not being used by another operator. The equipment must be in operating condition and the transmitters tuned to the correct frequency. The following subparagraphs give the sequence of operation.

(1) The operator selects the transmitter to be used from a chart. The chart lists the transmitters by number and the frequency at which they will transmit. Then the operator moves the TRANSMITTER SELECTOR switch to the on position. This causes the control circuits in the transmitter to operate connecting power to the blower motor and the filament transformers, and connecting bias and plate voltages to the tubes.

(2) The operator then turns the MODULATOR LINE switch to a modulator not in use if it is desired to modulate the selected transmitter. The operator then dials the number of the transmitter that is to be used. This connects the modulator control circuits as well as the modulated high voltage to the selected transmitter and connects the high voltage from the correct rectifier to modulator. Keying the transmitter now energizes the modulator.

b. Teletypewriter and C-W Operation. The modulator has no function during teletypewriter or c-w operation. The operation of the MODULATOR LINE switch and dial are omitted at the control console.

CHAPTER 5

FIELD MAINTENANCE INSTRUCTIONS

Note: This chapter contains information for field maintenance. The amount of repair that can be performed by units that have field maintenance responsibility is limited only by the tools and test equipment available, and by the skill of the repairman.

SECTION I.
TROUBLE SHOOTING AT FIELD MAINTENANCE LEVEL

Warning: When servicing Modulator Type 50H, be extremely careful because of the high voltages that may still be present in the dircuit even after the equipment is shut down. Always disconnect the h-v leads after the rectifier power unit is shut down and the filter capacitors in the rectifier power unit are discharged. First ground out the filter capacitors C-1, C-108, and C-109 with a shorting bar. Keep one hand in your pocket when measuring voltages with the probe. Before touching any part after the power is shut off, short the part to ground (par. 59).

56. Trouble-shooting Procedures.

The first step in servicing a defective modulator is to sectionalize the fault. Sectionalization means tracing the fault to the major component or circuit responsible for the abnormal operation of the set. The second step is to localize the fault. Localization means tracing the fault to the defective part responsible for the abnormal operation. Some faults such as burned-out resistors, arcing, and shorted transformers or capacitors, can often be located by sight, smell, and hearing. Many faults, however, must be localized by checking voltage and resistance. Remember that most faults are caused by defective tubes.

a. System Sectionalization. System sectionalization is discussed in paragraph 41.

b. Component Sectionalization and Localization. The tests in this section aid in isolating the source of trouble. To be effective, the procedure should be followed in the order given. Remember that servicing procedure should cause no further damage to the equipment. First, trouble should be localized to a single stage or circuit. Then the trouble may be isolated within that stage or circuit by appropriate voltage, resistance, and continuity measurements. The service procedure is summarized as follows:

(1) Visual inspection. Through this inspection alone, (32) the repairman may frequently discover the trouble or determine the stage in which the trouble exists. The inspection is valuable in avoiding additional damage to the equipment which might occur through improper servicing methods and in forestalling future failures.

(2) Power supply test. The power supply test (par. 60) prevents further damage to the transmitter or rectifier from certain possible short circuits. Since this gives an indication of the operation of the rectifier and its filter circuits, its function is more often preventive.

(3) Operational test. The operational test (par. 61) is important because it frequently indicates the general location of the trouble. In many instances the information gained will determine the exact nature of the fault. In order to utilize this information fully, all results must be interpreted in relation to each other.

(4) Trouble-shooting chart. The trouble symptoms listed in this chart will aid greatly in localizing trouble.

(5) Intermittents. In all of these tests, the possibility of intermittents must not be overlooked. If present, this type of trouble often may be made to appear by tapping or jarring the parts. It is possible that the trouble is not in the modulator itself but in the installation (keying lines, remote control unit, or rectifier). In this event, test the installation, if possible.

57. Trouble-shooting Data.

Take advantage of the material supplied in this manual. It will help in the rapid location of faults. Consult the following trouble shooting data:

Fig. or par. No.	Description
Fig. 37	Modulator Type 50H, schematic diagram.
Fig. 13	Modulator Type 50H, tube location diagram.
Par. 41	System sectionalization of trouble to a component.
Par. 43	Equipment performance checklist.
Fig. 30	Modulator Type 50H, front view of cabinet and components.
Fig. 31	Modulator Type 50H, rear view of cabinet and components.
Par. 62	Trouble-shooting chart for the amplifier chassis.
Fig. 32	Modulator Type 50H, top view of amplifier chassis.
Fig. 33	Modulator Type 50H, bottom view of amplifier chassis.
Par. 63	Trouble-shooting chart for dialing and auxiliary relay unit.
Fig. 34	Modulator Type 50H, tube socket resistance voltage chart.
Fig. 35	Modulator Type 50H, top view of dialing and auxiliary relay unit.
Fig. 36	Modulator Type 50H, bottom view of dialing and auxiliary relay unit.
Par. 64	D-c resistances of transformers, reactors, and relay coils.
Par. 66	Typical panel meter readings.

58. Test Equipment Required for Trouble Shooting

The test equipment required for trouble shooting Modulator Type 50H is listed below.

Test equipment
Oscillator I-151A or equal
Tube Tester I-177 or equal
Multitester TS-352/U or equal
Oscilloscope BC-1060 or equal

59. General Precautions.

Whenever a modulator is to be serviced, observe the following precautions carefully:

a. High Voltages. Be careful when the front bottom safety panel is removed; dangerous voltages are exposed.

b. Replacing Parts. Careless replacement of parts often makes new faults. Note the following points:

(1) Before a part is unsoldered or disconnected, note the position of the leads. If a part such as a transformer has a number of connections, tag each of the leads to it.

(2) Be careful not to damage other leads by pulling or pushing them out of the way.

(3) Do not allow drops of solder to fall into the set; they may cause a short circuit.

(4) A carelessly soldered connection may create a new fault. It is very important to make well-soldered joints, since a poorly soldered joint is one of the most difficult faults to find.

(5) When a part is replaced, it must be replaced exactly as the original one. Give particular attention to grounding when replacing a part. Use the same ground point as in the original wiring. Failure to observe these precautions may result in decreased gain, increased hum, or possibly in faulty operation of the circuit.

c. Resistance Measurements. An ohmmeter is used in resistance measurements in servicing defective equipment. Shut down the equipment before making resistance measurements. Zero adjust the ohmmeter. This adjustment consists merely of turning the zero-adjustment knob or screw so that meter reads zero ohms when the probes are short circuited and must be made every time the ohmmeter scale is changed. This zero adjustment is not to be confused with the needle adjustment on the lower center of the meter face. Most trouble shooting on this equipment will be performed using resistance measurements and the trouble-shooting charts (par. 62 and 63), therefore observe the following points:

(1) Unless otherwise specified, the resistance values listed on figure 34 are measured between the indicated points and ground (chassis).

(2) All tubes are in their sockets (when checking for above resistance measurements).

(3) No audio input to modulate (disconnect incoming audio lines from audio terminals 37 and 39 at cabinet terminal board E-1).

(4) R-129 (BIAS PROTECTION) and R-138 (OVERLOAD ADJUSTMENT) adjusted normally, about midposition or sealed position.

(5) R-133 (BIAS ADJUSTMENT) adjusted to give -220 volts bias as read by MODULATOR BIAS meter (sealed position).

(6) If values are other than normal, take a resistance reading across each component listed as defective in the probable trouble column before replacing.

d. Voltage Measurements. It is not recommended that voltage measurements be taken when trouble shooting this modulator because of the dangerous high voltages present. These voltages can only be checked with the doors and/or rear panel removed or open, and the interlocks shorted out. Therefore, in performing any voltage check or measurement in the modulator, the repairman will be exposed to dangerous voltages which can be fatal. However, if the trouble cannot be located by any other means, and voltage checks must be made, follow the precautions below (See warning notice in front of this book.)

(1) Connect the ground lead to the voltmeter.

(2) Place one hand in your pocket. This will eliminate the possibility of making accidental contact with either ground or another part of the circuit, causing electricity to travel from one hand to the other.

(3) If the voltage is greater than 500 volts, shut off the power, connect the hot lead, step away from the voltmeter, turn on the power, and note the reading of the voltmeter. Do not touch any part of the voltmeter, particularly when it is necessary to measure the voltage between two points which are above ground potential.

(4) Always begin by setting the voltmeter on the highest range, so that the voltmeter will not be overloaded. If it is necessary to obtain increased accuracy, set the voltmeter to a lower range.

(5) It is necessary that the resistance of the voltmeter be at least 10 times as large as the resistance of the circuit across which the voltage is measured. If the voltmeter resistance is comparable to the circuit resistance, the voltmeter will indicate a voltage lower than the actual voltage which is present when the voltmeter is removed from the circuit.

(6) The resistance of the voltmeter on any range can always be calculated by the following simple rule: resistance of the voltmeter equals the ohms per volt multiplied by the full-scale range in volts. For example: the resistance of 1,000-ohms-per-voltmeter on the 300-volt range is 300,000 ohms. (R = 1,000 ohms per volt x 300 volts = 300,00 ohms.)

60. Checking Circuits for Shorts

Trouble within the modulator circuit may often be detected by taking circuit resistance measurements using the trouble-shooting chart and figure 35. In addition, resistance checks of the h-v circuits must be made before applying power to prevent damage to the power supplies, filter reactor, filter capacitor, and the modulation transformer. Make the following resistance checks before attempting to put the equipment into operation and correct all abnormal conditions before applying power.

a. Terminals E-201 and E-203 should show open circuits to ground.

b. Terminal E-202 should be approximately 160,000 ohms to ground.

c. With all fuses removed, there should be an open circuit between terminals 35 and 36 on the terminal board.

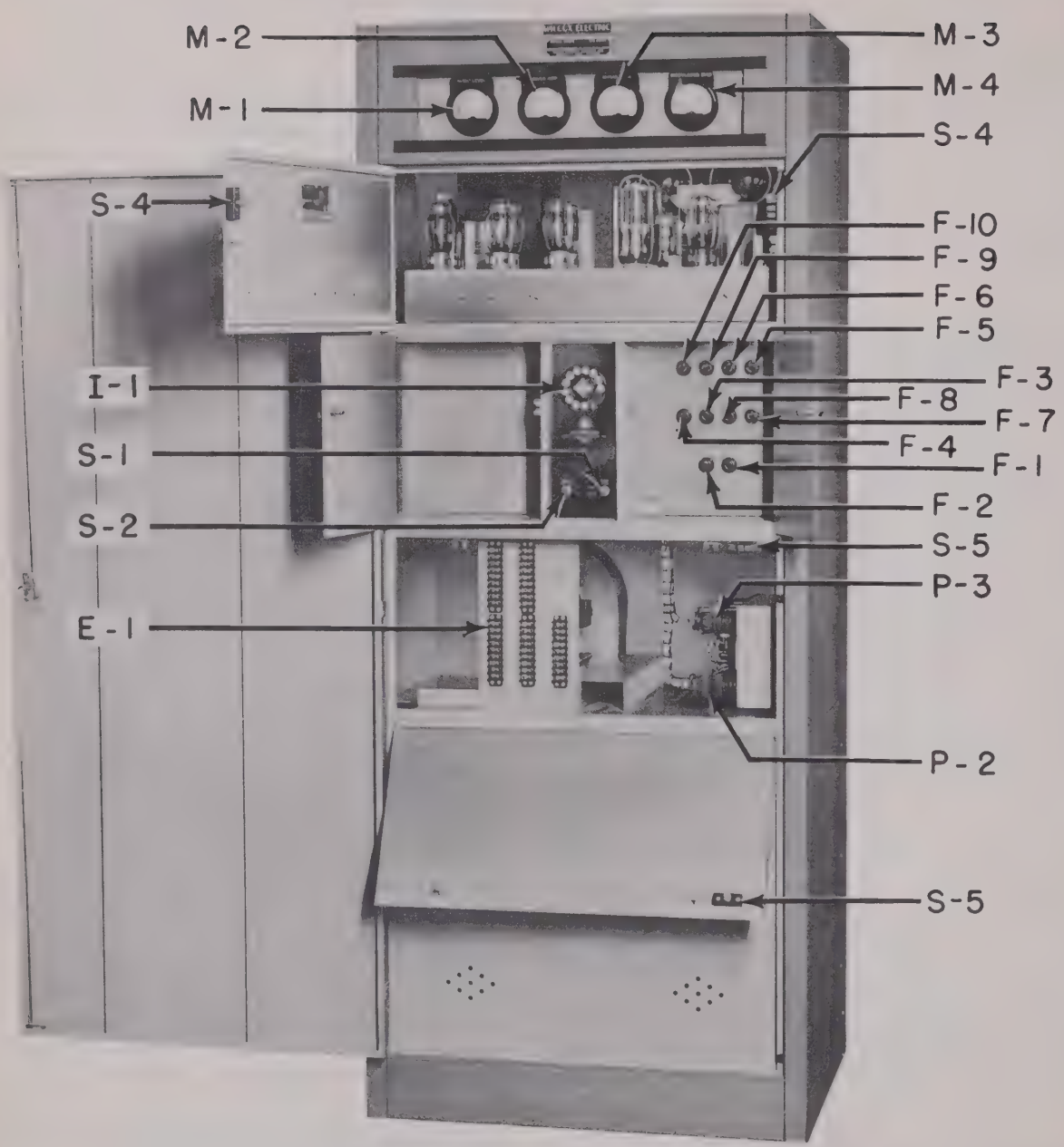


Figure 30. Modulator Type 50H, front view of cabinet with operating components

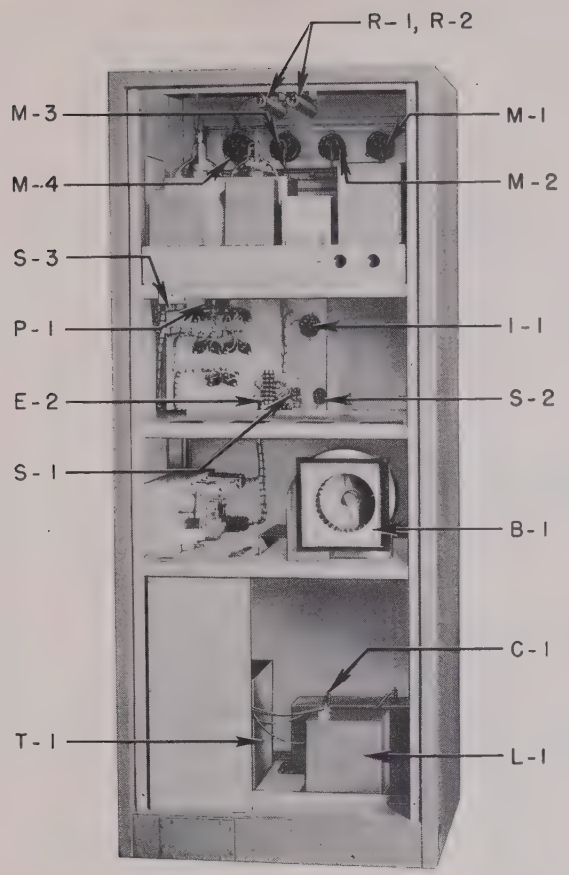


Figure 31. Modulator Type 50H, rear view of cabinet with operating components

61. Operational Tests

Operate the equipment as described in paragraph 43, the equipment performance checklist. The equipment performance is important because it usually indicates the general location of the trouble.

62. Trouble-shooting Chart for Amplifier Chassis (figs. 32, 33, and 34)

The following chart is supplied as an aid in locating trouble in the modulator chassis. However, before using this chart, operate the equipment following paragraph 41, system sectionalization of trouble to a component, to determine if the trouble lies in the modulator or its associated equipment. Then use the equipment performance checklist (par. 43) to localize the trouble to a particular unit or section such as the amplifier or dialing unit. A visual inspection of this unit plus tube tests should now be made before going ahead with the resistance checks on the trouble-shooting chart. The chart itself is broken down into six major groups and lists the symptoms which may be observed when taking resistance measurements. Refer to figure 34, Modulator Type 50H, tube socket resistance and voltage chart and paragraph 59 for setting of controls and the correct resistance values. Before replacing,, check suspected resistors for tolerance. Use continuity checks before undertaking to replace major components.

a. Localizing Trouble in Amplifier Phase Inverter Stage.

Symptom	Probable trouble	Correction
1. All reistances at pins of V-101 normal except:		
a. Resistance at pin 1.	Resistor R-103 defective.	Replace R-103.
b. Resistance at pin 2.	Resistor R-101 defective.	Replace R-101.
c. Resistances at pins 3 and 8.	Resistor R-102 defective. Capacitor C-101 shorted.	Replace R-102. Replace C-101.
d. Resistance at pins 4 and 5 or pin 9.	Open secondary winding in transformer T-102.	Replace T-102.

a. Localizing Trouble in Amplifier Phase Inverter Stage (contd).

Symptom	Probable trouble	Correction
e. Resistance at pin 7.	Resistor R-105, R-106, R-107, or R-108 defective.	Replace defective resistor.
f. Resistances at pins 1 and 6.	Resistor R-109 or R-128 defective. Capacitor C-104, C-109, or C-108 shorted.	Replace defective component.
g. Resistances at pins 1, 6, and 7 below normal.	Capactior C-102 or C-103 shorted.	Replace C-102 or C-103.

b. Localizing Trouble in Amplifier Stage.

Symptom	Probable trouble	Correction
2. All resistances at pins of V-102 normal except:		
a. Resistance at pins 1 or 5.	Open secondary winding in transformer T-102.	Replace T-102.
b. Resistance at pin 3.	Resistor R-105, R-106, R-107, or R-108 defective. Capacitor C-102 or C-103 shorted.	Replace defective component.
c. Resistance at pin 4.	Resistor R-110 defective.	Replace R-110.
d. Resistance at pin 2.	Resistor R-111 or R-112 defective.	Replace defective resistor.
e. Resistance at plate cap.	Resistor R-113 or R-114 defective. Capacitor C-105, C-106, C-108, or C-109 shorted.	Replace defective resistor component.
f. Resistances at plate cap and pin 2.	Resistor R-127 or R-128 open.	Replace defective resistor.
3. All resistances at pins of V-103 normal except:		
a. Resistance at pins 1 or 5.	Open secondary winding in transformer T-102.	Replace T-102.
b. Resistance at pin 3.	Resistor R-105, R-106, R-107, or R-108 defective. Capacitor C-102 or C-103 shorted.	Replace defective component.
c. Resistance at pin 4.	Resistor R-110 defective.	Replace R-110.
d. Resistance at pin 2.	Resistor R-111 or R-112 defective.	Replace defective resistor.
e. Resistance at plate cap.	Resistor R-115 or R-116 defective. Capacitor C-105, C-106, C-108 or C-109 shorted.	Replace defective component.
f. Resistances at plate cap and pin 2.	Resistor R-127 or R-128 open.	Replace defective resistor.

c. Localizing Trouble in Driver Stage.

Symptom	Probable trouble	Correction
4. All resistances at pins of V-104 normal except:		
a. Resistance at pin 1.	Resistor R-117 defective. Capacitor C-105 shorted.	Replace defective component.
b. Resistance at pins 2 or 4.	Open secondary winding in transformer T-102.	Replace T-102.
c. Resistances at both pins 2 and 4.	Resistor R-122 or R-124 defective.	Replace defective resistor.
d. Resistance at pin 3.	Primary of transformer T-101 open or grounded Resistor R-125, R-126, R-127, or R-128 defective. Capacitor C-108 or C-109 shorted.	Replace defective component.
5. All resistances at pins of V-105 normal except:		
a. Resistance at pin 1.	Resistor R-118 defective. Capacitor C-106 shorted.	Replace defective component.
b. Resistace at pins 2 or 4.	Open secondary winding in transformer T-102.	Replace T-102.
c. Resistances at both pins 2 and 4.	Resistor R-123 or R-124 defective.	Replace defective resistor.
d. Resistance at pin 3.	Primary of transformer T-101 open or grounded. Resistor R-125, R-126, R-127, or R-128 defective. Capacitor C-108 or C-109 shorted.	Replace defective component.

d. Localizing Trouble in Modulator Stage.

Symptom	Probable trouble	Correction
6. All resistances at pins and caps of V-106 and V-107 normal except:		
a. Resistances at pins 1, 2, 3, and 4.	Secondary of transformer T-103 grounded.	Replace T-103.
b. Resistance at grid caps.	Secondary of transformer T-101 open or grounded. Resistor R-136, R-133, R-132, R-131, or R-130 defective. Capacitor C-107, C-111 or C-110 shorted. Coil of relay 0-101 open or grounded.	Replace defective component.
c. Resistance at plate caps.	Winding of transformer T-1 open or grounded. Resistor R-1 or R-2 defective. Capacitor C-1 shorted. Reactor L-1 grounded.	Replace defective component.

e. Localizing Trouble in Plate and Screen Power Supply.

Symptom	Probable trouble	Correction
7. All resistances at pins of V-108 and/or V-109 normal except:		
a. Resistances at pins 4 and 6.	Defective ground connection to pins.	Repair or replace ground connection.
b. Resistances at pins 2 and 8.	Secondary of transformer T-104 or T-105 grounded.	Replace defective transformer.
8. All resistances at pins of V-110 and/or V-111 normal except:		
a. Resistances at pins 4 and 6.	Secondary of transformer T-104 or T-105 grounded.	Replace defective transformer.
b. Resistances at pins 2 and 8.	Secondary of transformer T-105 open or grounded. Reactor L-101 open or grounded. Resistor R-125, R-126, R-127, or R-128 defective. Capacitor C-108 or C-109 shorted.	Replace defective component.

f. Localizing Trouble in Bias Supply Rectifier and Bias Regulator.

Symptom	Probable trouble	Correction
9. All resistances at pins of V-112 normal except:		
a. Resistance at pins 2 or 8 not normal.	Secondary winding of transformer T-106 open.	Replace T-106.
b. Resistances at pins 4 or 6 not normal.	Secondary winding of transformer T-106 open or grounded. Coil of relay 0-101 open or grounded. Resistor R-130, R-131, R-132, or R-133 defective. Capacitor C-107 or C-111 shorted. Secondary of transformer T-101 grounded.	Replace defective component.
10. All resistances at pins of V-113 normal except:		
a. Resistance at pin 1 or 5 (see f).	Secondary winding of T-106 open.	Replace T-106.
b. Resistance at pin 2.	Resistor R-137 defective.	Replace R-137.
c. Resistance at pin 3.	Resistor R-135, R-134, or R-133 defective. Capacitor C-110 shorted.	Replace defective component.
d. Resistance at pin 4 (see f).	Broken or corroded connection to tube socket.	Repair or replace connection.

f. Localizing Trouble in Bias Supply Rectifier and Bias Regulator (contd).

Symptom	Probable trouble	Correction
e. Resistance at plate cap.	Broken or corroded connection to plate cap.	Repair or replace connection.
f. Resistances at pins 1, 3, 4, and 5.	Defective component in bias supply rectifier, (see 9b).	See 9b.

g. Localizing Trouble at Receptacle J-101.

Symptom	Probable trouble	Correction
11. All resistances at J-101 normal except:		
a. Resistances at terminals A, B, and C.	Resistor R-124 defective. Secondary of transformer T-102 grounded.	Replace R-124. Replace T-102.
b. Resistance at terminal B.	Resistor R-122 open.	Replace R-122.
c. Resistance at terminal C.	Resistor R-123 open.	Replace R-123.
d. Resistance at terminal D.	Secondary of transformer T-103 grounded.	Replace T-103.
e. Resistances at terminals E and F.	Primary of transformer T-102 or T-105 grounded.	Replace T-102 or T-105.
f. Resistances at terminals G and H.	Primary of transformer T-104 grounded.	Replace T-104.
g. Resistances at terminals I and O.	Resistors R-119, R-120, or R-121 defective.	Replace defective resistor.
h. Resistances at terminals I, J, and O.	Defective component in grid circuit of modulator stage. Refer to 6b and 9b.	See 6b and 9b.
i. Resistances at terminals M and N.	Primary of transformer T-106 grounded.	Replace T-106.
j. Resistance at terminal P.	R-138 not adjusted properly or defective.	Adjust R-138 (Refer Chapter 2 Section III, Adjustment of Equipment). Replace R-138.
k. Resistance at terminal R.	Broken or corroded ground connection.	Repair or replace connection.
l. Resistance at terminal S.	Defective insulation at contact of relay 0-101.	Replace 0-101.
m. Resistance at terminal T.	Primary of transformer T-103 grounded.	Replace T-103.
n. Resistance at terminal U.	Resistor R-101 defective.	Replace R-101.
o. Resistance at terminal V.	Broken or corroded connection.	Repair or replace connection.
p. Resistance at terminal W.	Broken or corroded ground connection.	Repair or replace connection.

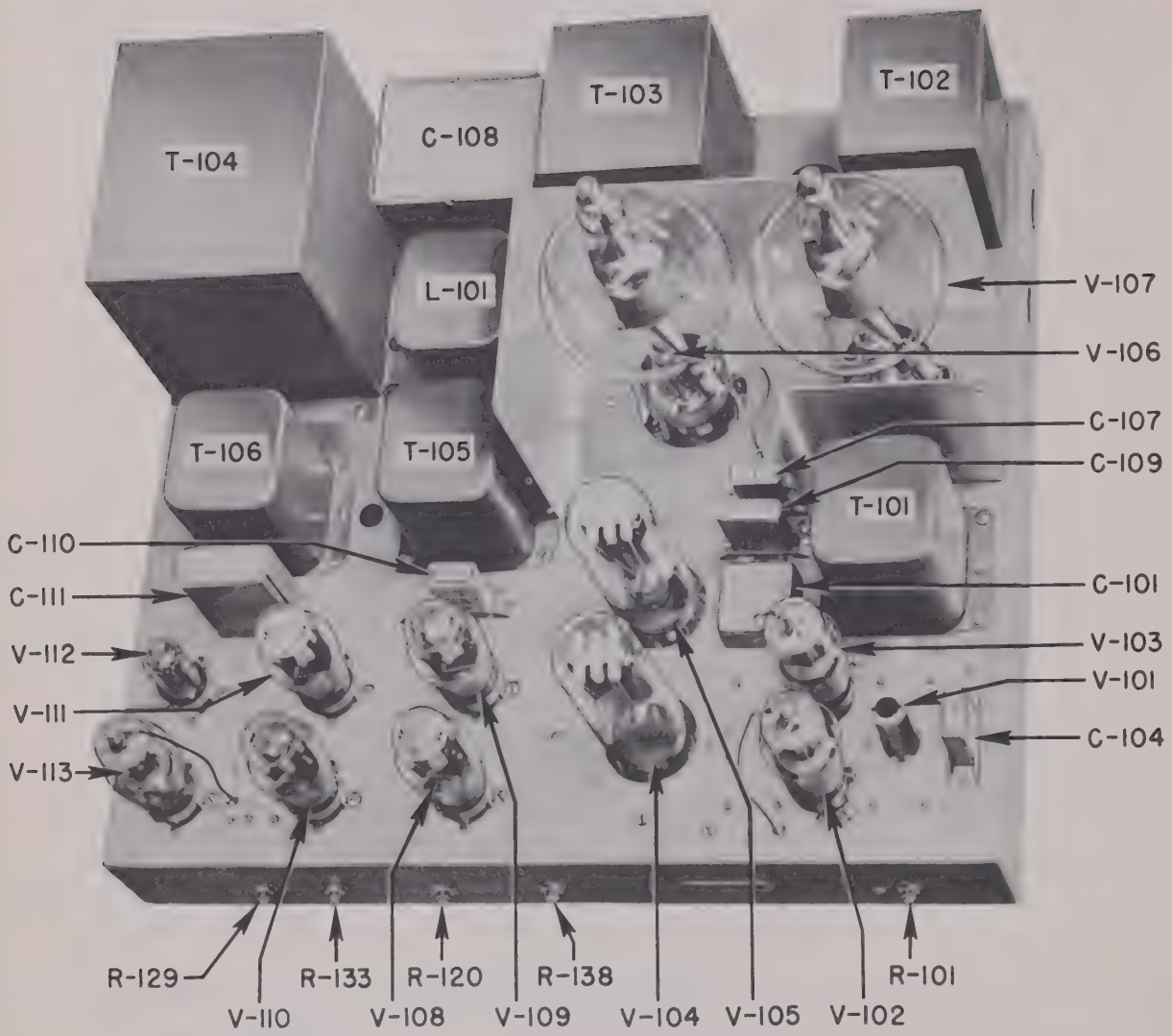


Figure 32. Modulator Type 50H, top view of amplifier chassis

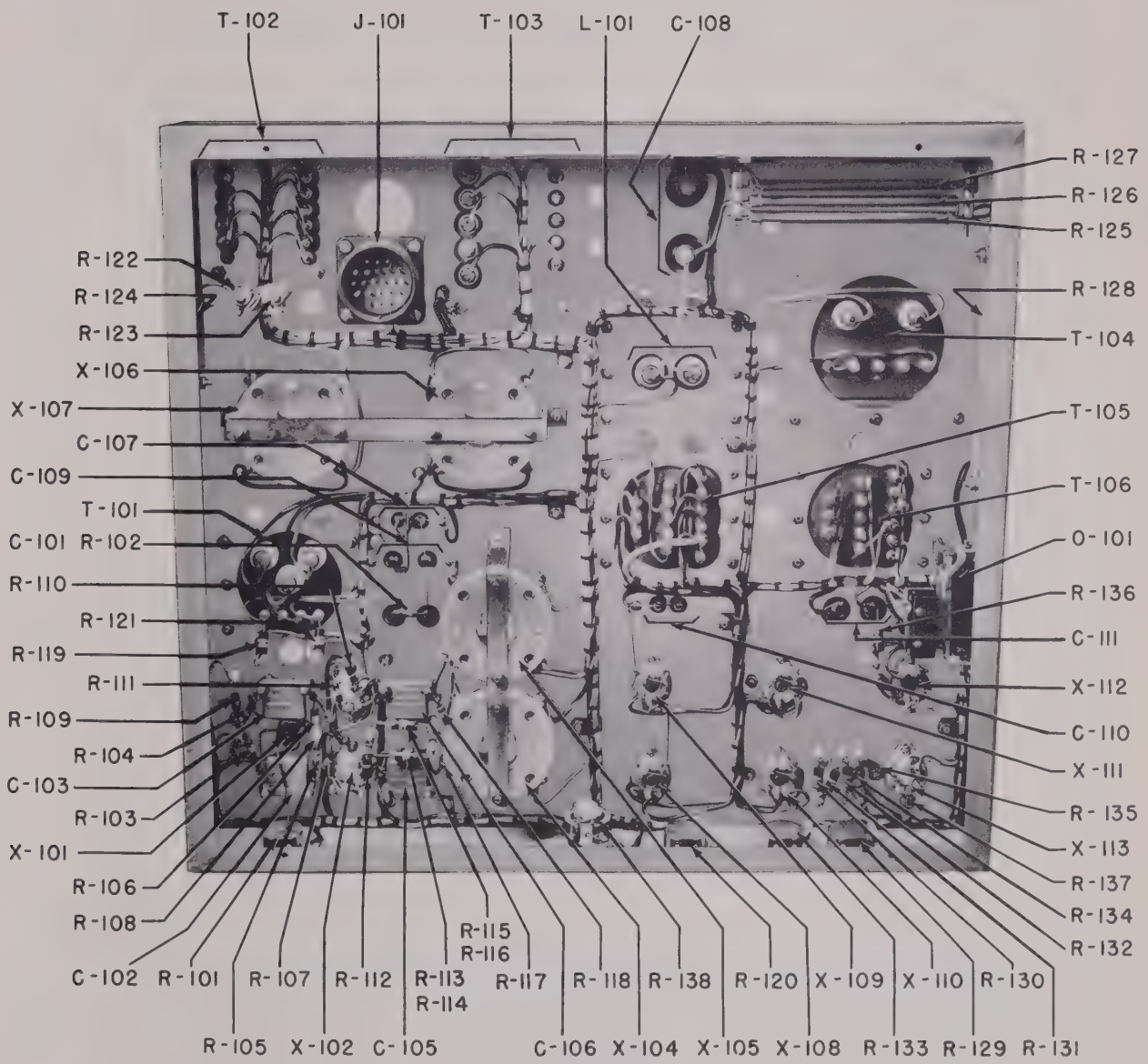


Figure 33. Modulator Type 50H, bottom view of amplifier chassis

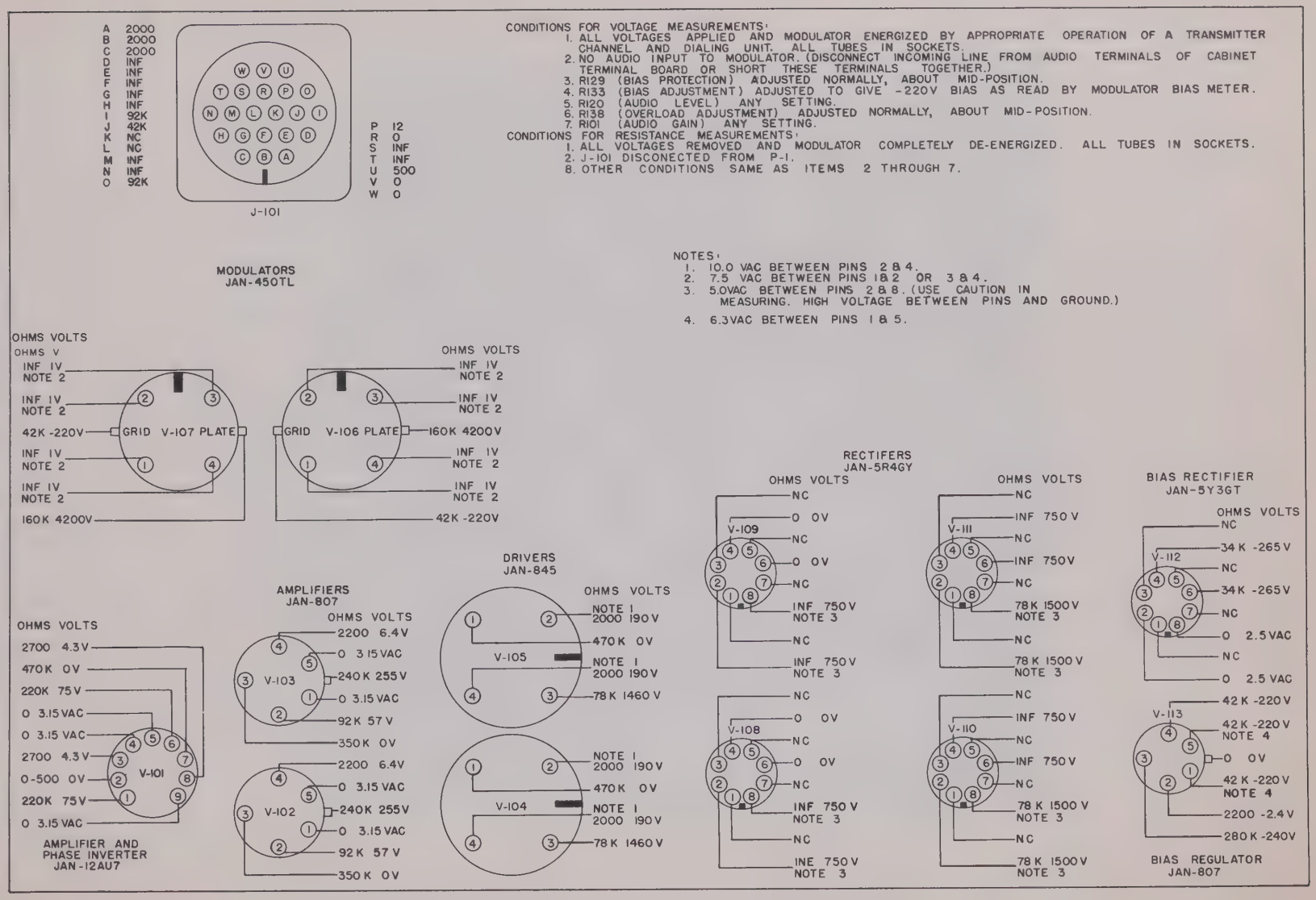


Figure 34. Modulator Type 50H, tube socket with voltage and resistance chart

63. Trouble-shooting Chart for Dialing and Auxiliary Relay Unit (figs. 35 and 36)

The following chart is supplied as an aid in locating trouble in the dialing and auxiliary relay unit. The chart is broken down into two major groups, the dialing system and the auxiliary control.

a. Localizing Trouble in Dialing System.

Symptom	Probable trouble	Correction
1. Relay 0-201 operates from local dial but not from remote dial.	1. Switch S-201 in wrong position. No dialing pulses from remote control line. Rectifier CR-201 defective. Transformer T-201 shorted. Capacitor C-202 open (if simplex dialing is used).	1. Place S-201 in correct position. Repair remote control line or remote control console. Replace CR-201. Replace T-201. Replace C-202.
2. Relay 0-201 operates from remote dial but not from local dial.	2. No voltage from 12-volt supply in rectifier. Local dial I-1 defective.	2. Repair 12-volt supply. Repair or replace I-1.
3. Relay 0-201 operates from local and remote dial but relay 0-202 does not operate on a dialing sequence.	3. Bad contacts on relay 0-201. Bad contacts on off-normal switch of relay K-201. Relay 0-202 defective.	3. Clean or adjust contacts of 0-201 or replace 0-201. Clean or adjust off-normal contacts. Replace K-201. Replace 0-202.
4. Relay 0-202 does not remain closed during dialing sequence.	4. Residual screw on relay 0-202 in too far. Low voltage from 12-volt supply.	4. Back out residual screw until relay remains closed between dialing pulses (par. 65). Repair 12-volt supply.
5. Relays 0-201 and 0-202 operate properly but relay 0-203 does not close during dialing sequence.	5. Bad contacts on relay 0-202. Bad contacts on relay 0-204. Relay 0-203 defective.	5. Clean or adjust contacts of 0-202 or replace 0-202. Clean or adjust contacts of 0-204 or replace 0-204. Replace 0-203.
6. Stepping relay K-201 does not operate during dialing sequence although relays 0-201, 0-202, and 0-203 operate properly.	6. Bad contacts on relay 0-203. Bad contacts on relay 0-204. Relay K-201 defective.	6. Clean or adjust contacts of 0-203 or replace 0-203. Clean or adjust contacts of 0-204 or replace 0-204. Replace K-201.
7. Relay 0-204 does not operate on first pulse of dialing sequence when stepping relay is not at home position.	7. Bad contacts on off-normal switch of relay K-201. Bad contacts on relay 0-204. Bad contacts on relay 0-203. Relay 0-204 defective.	7. Clean or adjust off-normal contacts. Clean or adjust contacts of 0-204. Clean or adjust contacts of 0-203. Replace 0-204.
8. Relay 0-204 does not operate upon releasing transmitter selector switch at remote control console when stepping relay is not at home.	8. Bad modulator release contacts in transmitter relay. Bad contacts in bank four of relay K-201.	8. Clean relay contacts in transmitter. Clean contacts in bank four of K-201.
9. Stepping relay K-201 does not home after relay 0-204 operates.	9. Bad contacts on relay 0-204. Bad contacts in interrupter switch of relay K-201. Bad contacts in bank five of relay K-201. K-201 defective.	9. Clean 0-204 contacts. Clean K-201 interrupter switch contacts. Clean K-201 bank five contacts. Replace K-201.

a. Localizing Trouble in Dialing System. (contd).

Symptom	Probable trouble	Correction
10. Relay 0-209 does not operate when numbers one to five are dialed.	10. Bad contacts in bank three of relay K-201. Coil of relay 0-209 defective. Contact assembly of 0-209 defective. Bad contacts on relay 0-204. Bad contacts on relay 0-202.	10. Clean K-201 bank three contacts. Replace coil of 0-209. Replace contact assembly of 0-209. Clean 0-204 contacts. Clean 0-202 contacts.
11. Relay 0-208 does not operate when numbers 6 to 10 are dialed.	11. Bad contacts in bank three of relay K-201. Coil of relay 0-208 defective. Contact assembly of 0-208 defective.	11. Clean K-201 bank three contacts. Replace coil of 0-208. Replace contact assembly of 0-208.
12. H-v switching relays in rectifier power unit do not operate when corresponding numbers are dialed.	12. Bad contacts in bank two of relay K-201. Defective h-v switching relays in rectifier power unit.	12. Clean K-201 bank two contacts. Repair or replace h-v relays in rectifier.
13. Relay 0-206 does not close.	13. Fuses F-1 and/or F-2 blown. Relay 0-206 defective.	13. Replace F-1 and/or F-2. (Defective blower motor may cause F-1 or F-2 to blow) Repair or replace 0-206.
14. Relay 0-205 does not close when selected transmitter is keyed.	14. Underload adjustment in transmitter improperly set. Bad contacts in bank one of relay K-201. Bad contacts on 0-206. Relay 0-205 defective. Bad contacts on relay 0-207.	14. Adjust transmitter underload properly. Clean K-201 bank one contacts. Clean 0-206 contacts. Repair or replace 0-205 Clean 0-207 contacts.
15. Filaments of modulator tubes V-106 and V-107 do not light when selected transmitter is keyed.	15. Fuses F-5 and/or F-6 blown. Bad contacts on relay 0-205.	15. Replace F-5 and/or F-6. Clean 0-205 contacts.

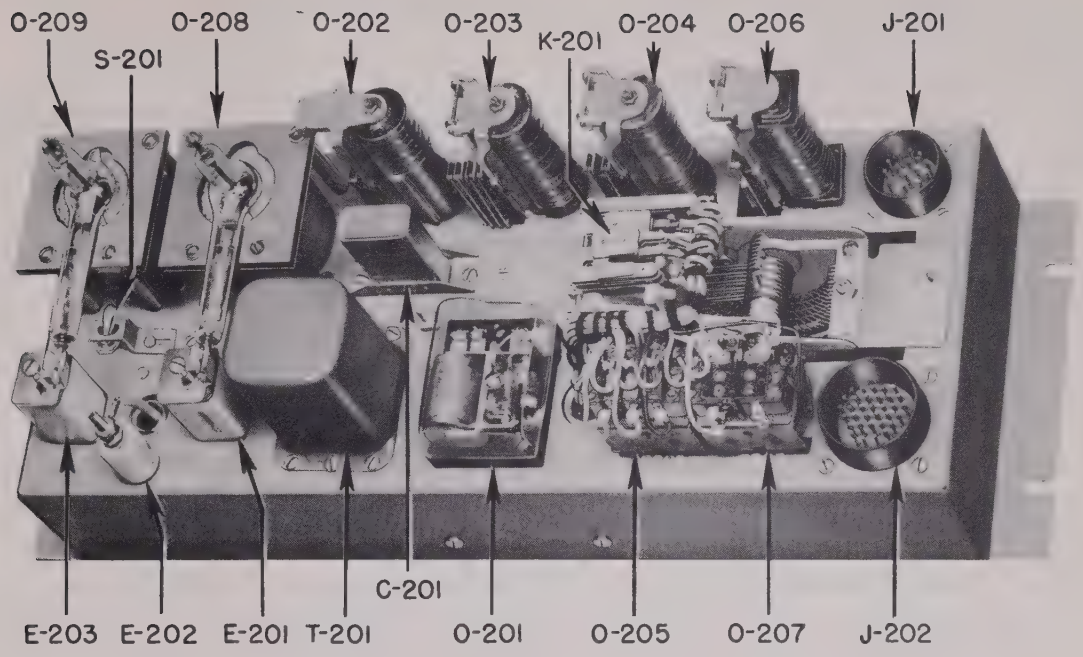


Figure 35. Modulator Type 50H, top view of dialing and auxiliary relay unit

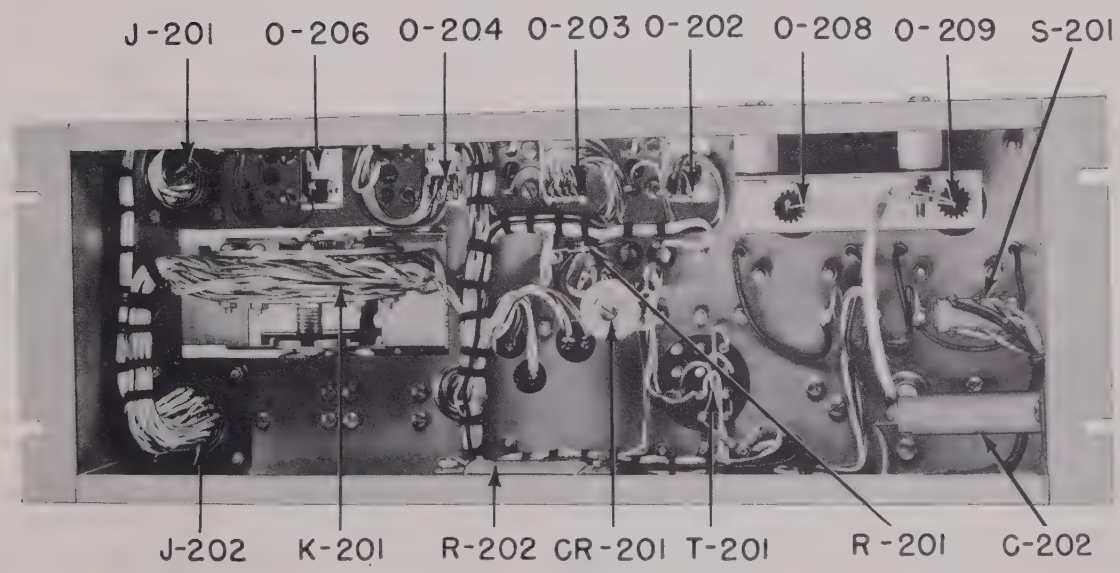


Figure 36. Modulator Type 50H, bottom view of dialing and auxiliary relay unit

64. D-c Resistances of transformers, reactors, and relay coils.

The d-c resistances of the transformer and reactor windings and relay coils in the modulator, are listed below:

Symbol	Winding	Terminal Nos.	Resistance
T-1		1 to 5	34.6 ohms
T-101	Primary	5 to 7	272.0
T-101	Secondary	1 to 2	53.7
T-101	Secondary	3 to 4	61.8
T-102	Primary	1 to 5	6.8
T-102	Seoondary	6 to 8	.067
T-102	Secondary	9 to 11	.067
T-102	Secondary	12 to 14	.050
T-103	Primary	1 to 5	2.1
T-103	Secondary	6 to 8	less than .01
T-104	Primary	1 to 5	2.1
T-104	Secondary	6 to 7	210.0
T-105	Primary	1 to 5	20.0
T-105	Secondary	6 to 8	.030
T-105	Secondary	9 to 11	.074
T-105	Secondary	12 to 14	.077
T-106	Primary	1 to 5	39.0
T-106	Secondary	6 to 8	440.0
T-106	Secondary	9 to 11	.205
T-106	Secondary	12 to 14	.072
T-201	Primary	3 to 6	10.5
T-201	Primary	7 to 10	10.5
T-201	Secondary	1 to 2	46.2
L-1		1 to 2	6.55
L-101		1 to 2	120.0
0-101			3300
0-201			400
0-202			125
0-203			200
0-204			200
0-205			70
0-206			360
0-207			70
0-208			30
0-209			30
K-201			10

65. Adjusting Residual Screw of Relay 0-202

Adjust the residual screw to give a .0015-inch clearance between the relay armature and core when the relay is operated. After making this adjustment, test for proper operation by observing that the relay stays closed during a dialing sequence and that it releases approximately one-half second after the end of the last pulse of the dialing sequence. If the relay does not remain closed during the dialing sequence, decrease the above clearance. If the relay remains closed for considerably more than a half second after the last pulse, increase the clearance.

66. Typical Panel Meter Readings

The panel reading chart given in this paragraph lists the typical readings for power output levels of 400, 800, 1,200, and 1,600 watts. Use this chart as a standard to check the approximate power output with a given input, before and after trouble shooting. A check of the meter readings and comparison with this chart will indicate the approximate audio output of the modulator. It will indicate if the input to the modulator is sufficient to drive the modulator to its full output or to the output desired.

	AUDIO LEVEL (a.)		DRIVER AMP (b.)		MODULATOR		MODULATOR BIAS	
Power output	Sine wave	Speech (c)	Sine wave	Speech	Sine wave	Speech (c)	Sine wave	Speech
	(db)	(db)	(ma)	(ma)	(ma)	(ma)	(volts)	(volts)
400 watts	-6.0	-9.0	50	50	285	170	220	220
800 watts	-3.0	-6.0	50	50	400	220	225	220
1,200 watts	-1.2	-4.2	50	50	490	260	227	222
1,600 watts	0	-3.0	50	50	580	300	230	225

a. With AUDIO LEVEL switch in OUTPUT position. Reading of meter when AUDIO LEVEL switch is in INPUT position depends on magnitude of audio voltage applied to input of modulator.

b. With DRIVER CURRENT switch in either V-104 or V-105 position.

c. Subject to considerable variation, depending on the particular voice and the amount of compression or clipping of the speech before applying to the modulator input.

SECTION II. REPAIRS

67. Replacement of Parts.

a. All of the parts in Modulator Type 50H are readily accessible, when the amplifier chassis and dialing and auxiliary relay unit are removed, and are easily replaced if found to be faulty. If any of the relay switches or transformers require replacement, mark the wires connected to the faulty unit with tags or other devices to avoid misconnection when a new unit is installed. Follow this practice whenever replacement requires a disconnection of numerous wires.

b. The amplifier chassis, the dialing and auxiliary relay unit chassis, and the blower assembly are readily removed from the modulator cabinet. Also the filter capacitor, the filter reactor, and the modulation transformer are easily removed. The only necessary operation is to remove the screws that hold the various chassis or units in place, disconnect the cables, and remove the units. Access to the front of the fuse panel, control panel, and terminal board is obtained by opening the doors covering these units. The meters

are accessible from the rear when the amplifier chassis is removed. Access to the rear of the terminal board, control panel, and the fuse panel is obtained from the rear of the cabinet. It is advisable to remove the blower assembly before attempting work on the main terminal board.

68. Refinishing

When the equipment is disassembled, and before the installation of the component parts, is the best time to do the refinishing required.

69. Apparatus Adjustment

Few special adjustments are required. The meters are hermetically sealed and have no accessible zero adjustment. They should be replaced if the zero error becomes great enough to make accurate readings difficult. Do not replace the meter because of a zero error of three percent or less of full-scale reading. Relays should not be adjusted unless thorough investigation eliminates all other possible causes of trouble. In most cases, a relay that requires adjustment should be replaced. See paragraph 65 for adjustment of residual screw of relay 0-202. All initial adjustments are given in detail in paragraph 17.

SECTION III. FINAL TESTING

70. General

This section is intended as a guide to be used in determining the quality of a repaired Modulator Type 50H. The tests outlined in paragraphs 72 through 74 below may be performed by maintenance personnel with adequate test equipment and the necessary skills. Repaired equipment meeting these requirements will furnish uniformly satisfactory operation.

71. Test Equipment Required for Final Testing

The instruments and equipment needed for testing the repaired equipment are given below:

a. An audio signal generator with a voltage and db calibrated 500-ohm impedance output signal from 20 to 20,000 cycles in frequency. Use Audio Oscillator TS-421/U (Hewlett-Packard model 205AG).

b. A vacuum tube voltmeter capable of measuring rms (root mean square) a-c voltage as low as .01 volts and as high as 3,000 volts. Use Electronic Multimeter ME-6/U (Ballantine model 300A) with a "times 100" multiplier or equivalent.

c. A noise and distortion meter or analyzer capable of analyzing and measuring noise voltages and harmonic distortion components of electrical waveforms at audio frequencies, similar to Hewlett-Packard model 325B.

d. A multiscale a-c voltmeter with a range from 0 to 3,000 volts rms.

e. An ohmmeter for continuity tests.

f. Rectifier Power Unit Model 36D or another source of 12 volts dc for testing the dialing circuits of the modulator. If the power unit is not available, a test without high voltage on the modulator plates and transformer T-1 can be conducted which does not check the final stage and h-v switching and protective circuits.

g. Oscilloscope BC-1061-(*).

h. A 4,500-ohm resistor load bank capable of dissipating a minimum of 4,400 watts.

i. A load resistor of 14,500 ohms, 25 watts.

j. a 500-ohm, one watt resistor.

72. Amplifier Unit,

a. Connect the 14,500-ohm, 25-watt resistor across the grids of modulator tubes V-106 and V-107.

b. Set AUDIO GAIN control V-101 at maximum clockwise.

c. Apply 60 cps, 220 volts ac between terminals E and F, G and H, and M and N of receptacle J-101.

d. Apply a 1,000-cycle sinusoidal signal to terminals U and V of J-101, and adjust signal input until the measured voltage from grid to grid of the modulator tubes is 490 volts rms. Record rms input voltage which should be between .087 and .173 volts.

e. Apply a 400-cycle sinusoidal signal to terminals and adjust for 490 volts from grid to grid of modulator tubes. Record rms input volts.

f. Repeat with a 3,000-cycle signal and record the rms input voltage.

g. The rms input voltage ratio at 1,000-cycle input to 3,000-cycle input and at 1,000-cycle input to 400-cycle input, should not be more than 1.16 nor less than 0.861 (±1.3db).

h. Apply a 400-cycle signal and adjust the level to give 490 volts rms across the grids of V-106 and V-107. Using the noise and distortion meter, the measured distortion should not be more than 5 percent. If a noise and distortion meter is not available, use the oscilloscope. The output signal should appear reasonably free of distortion as viewed on the scope.

i. Disconnect the signal generator and connect a 500-ohm resistor across the input terminals U and V. With R-101 set at maximum clockwise, the measured noise should be -45 db or greater below rated output of 490 volts, as measured with the noise and distortion meter. If no noise and distortion meter is available, the output voltage measured with the vacuum tube voltmeter should be -45 db or greater below the 490-volt rms output.

73. Dialing and Auxiliary Relay Unit

The dialing unit should show proper stepping and releasing action. Connect this unit into the cabinet. If Rectifier Power Unit Model 36D, is available, using the 12-volts supply connect +12-volts dc to terminal 40 or 41, and -12 volts dc to terminal 42 or 43. If no power unit is available, use a 12-volt battery or other source of 12-volt d-c power. Using the ohmmeter to indicate continuity, proceed as follows:

a. Rectifier 1 Connection on E-1

MOD UNDERLOAD terminal grounded	Dial	Indication	MOD RELEASE terminal grounded	Indication
-1 (11)	1	Continuity between E-203 and E-202 h-v terminals. V-106 and V-107 tube filaments light.	-1 (6)	Continuity broken. Modulator tube filaments go out.
-2 (12)	2		-2 (7)	
-3 (13)	3		-3 (8)	
-4 (14)	4		-4 (9)	
-5 (15)	5		-5 (10)	

b. Rectifier 2 Connections on E-1.

MOD UNDERLOAD terminal grounded	Dial	Indication	MOD RELEASE terminal grounded	Indication
-1 (29)	1	Continuity between E-201 and E-202 h-v terminals. Modulator tube filaments light.	-1 (24)	Continuity broken. Modulaotr tube filaments go out.
-2 (30)	2		-2 (25)	
-3 (31)	3		-3 (26)	
-4 (32)	4		-4 (27)	
-5 (33)	5		-5 (28)	

Note. During dialing operation, no pulses corresponding to the number dialed shall appear across the AUDIO LEVEL meter. AUDIO LEVEL switch on the control panel set at INPUT position.

74. Complete Modulator

a. Operational Test If Rectifier Power Unit Model 36D is Available.

High voltage will be present during this test (par. 59). This test is made with all units in the cabinet, all tubes in sockets, the vacuum switches installed, and all connections made that are necessary for the operation of the modulator. The test will be conducted as follows:

(1) Connect dummy resistor load of 4,500 ohms to terminal 4 of modulation transformer T-1 and ground. Connect AC voltmeter with scale set for 3,000-4,000 volts across this load.

(2) Connect the modulator to the rectifier power unit as follows:

On E-1, 220 volts. 60 cps to terminals 35 and 36, +12 volts dc to terminal 40 or 41, -12 volt dc to teminal 42 or 43, Interlocks to terminals 44, and 45. And 4,200 volts dc to terminal E-201.

(3) Connect terminal 11, (RECTIFIER 1, MOD UNDERLOAD 1) to 42 or 43 on terminal board E-1.

(4) Apply 12 volts dc and 220 volts ac by turning on the power unit. The blower motor should start and all filaments should light except V-106 and V-107, and MOD BIAS meter should read -220 vdc.

(5) Dial number 1. V-106 and V-107 filaments should light and DRIVER AMP meter M-2 should indicate between 40 and 55 ma.

(6) Connect a 500-ohm, 1 watt resistor across terminals 37 and 39 of E-1. Apply the 4,200 volts dc by turning the high voltage on at the power unit. Turn R-101 maximum clockwise and note the rms noise or output voltage across the dummy load resistance. The limit is -40 db below rated output of 2,680 volts rms (approx 26.8 volts.

(7) Remove the 500-ohm resistor and connect audio generator across the same terminals. Apply 1,000 cps, turn R-101 maximum clockwise, and adjust signal input for 2,680 volts rms on meter across dummy load, The input voltage limits are between .135 and .174, and the MODULATOR current, .7 ampere maximum. The maximum percent distortion, using the noise and distortion meter, is 8 percent. Adjust AUDIO LEVEL control R-120 so that AUDIO LEVEL meter M-1 reads 0 db with switch S-1 in OUTPUT position and 2,680 volts rms measured across the dummy load. Seal R-120 with cement or glyptol.

(8) At 1,000 cps input, increase input until total current is .75 ampere on M-3. Turn R-138, OVERLOAD ADJUST control, counterclockwise, until overload relay 0-207 just starts to kick out. Decrease gain and then increase it and check current at which 0-207 starts to kick out. The limit is from .7 to .8 ampere. Seal R-138 with cement.

(9) With high voltage (4,200 volts dc) applied, try each door interlock to determine proper function.

b. Operational Test If No Rectifier Power Unit Model 36D is Available.

The modulator is in the same condition as for subparagraph a above. The test will be conducted as follows:

(1) Connect the 14,500-ohm, 25-watt resistor between the grids of the 450TL modulator tubes V-106 and V-107.

(2) Apply 220 volts ac 60 cps between terminals 35 and 36 on terminal board E-1, +12 volts dc to terminal 40 or 41, and -12 volts dc to terminal 42 or 43.

(3) Connect terminal 11 (RECTIFIER 1, MOD UNDERLOAD 1) to 42 or 43 on E-1, and turn on the input power. The blower motor should start, all filaments light except V-106 and V-107, and MOD BIAS meter should read -220 volts dc.

(4) Dial number 1. V-106 and V-107 should not be lighted for this test as extra grid current load is not desired.

(5) Connect a 500-ohm, 1 watt resistor across terminals 37 and 39 on E-1. Turn R-101 maximum clockwise and measure the rms noise or output rms voltage across the 14,500-ohm load resistor. The limit is -40 db below the rated putput of 490 volts (approximately 4.9 volts).

(6) Disconnect the 500-ohm resistor and connect the audio oscillator in place of the resistor across the same terminals. Apply a 1,000-cycle signal and with R-101 at maximum clockwise, adjust the input signal to give an output at the grids of V-106 and V-107 of 490 volts rms. The input signal voltage should be between .135 and .173 volts. Check the distortion with the noise and distortion meter. The maximum is 8 percent. Adjust the AUDIO LEVEL control R-120 so that the AUDIO LEVEL meter reads 0 db with switch S-1 in OUTPUT position, at 490 volts rms across the load resistor.

CHAPTER 6

SHIPMENT AND LIMITED STORAGE

SECTION I.
SHIPMENT AND LIMITED STORAGE

75. Disassembly

The following instructions are recommended as a guide for preparing the radio equipment for transportation and storage.

a. External Lines. Disconnect all control and keying lines and power lines. Reel up all lines on suitable reels.

b. Modulator. Disconnect the plugs on the amplifier and dialing and auxiliary relay units. Disconnect the h-v leads from the modulator tubes; V-106 and V-107; the filter reactor, L-1; the filter capacitor, C-1; the modulation transformer, T-1; and the three h-v leads on the stand-off insulators on the dialing and auxiliary relay unit. Remove the screws holding the amplifier chassis, the dialing and auxiliary relay unit, the filter reactor, the filter capacitor, the modulation transformer, and the blower assembly to the cabinet. Remove the components. Remove the tubes from the amplifier chassis and the vacuum-type h-v switches from the dialing and auxiliary relay unit.

76. Repacking for Shipment or Limited Storage

a. The exact procedure in repacking for shipment or limited storage depends upon the material available and the conditions under which the equipment is to be shipped or stored. Refer to paragraph 6 and follow in reverse order the instructions given.

b. Whenever practical, place a dehydrating agent such as silica gel inside the cases. Protect the cabinet with a waterproof paper barrier. Seal the seams of the paper barrier with a waterproof sealing compound or tape. Pack the protected cases in a padded wooden case, providing at least 3 inches of excelsior padding or some similar material between the paper barrier and the wooden case.

Abbreviations

a-c	alternating-current
a-f	audio-frequency
a-m	amplitude-modulated
amp	ampere
avc	automatic volume control
C	centigrade
cps	cycles per second
c-w	continuous-wave
d-c	direct-current
db	decible
DPDT	double-pole, double-throw
SPDT	single-pole, double-throw
F	Fahrenheit
ft	foot, feet
h-f	high-frequency
h-v	high-voltage
JAN	Joint Army-Navy
K	1,000 ohms
kc	kilocycle
kva	kilovolt-ampere
kw	kilowatt
l-f	low-frequency
l-v	low-voltage
ma	milliampere
mc	megacycle
mcw	modulated continuous-wave

APPENDIX I.
Identification Table of Parts for Modulator Type 50H

Ref symbol	Name of part and description	Function of part
	MODULATOR, radio: Modulator Type 50H; MCW and voice.	
	BLOWER: motor 1/6 hp 1725 rpm single ph, 220v AC 60 cps; 600 cfm displacement at 1725 rpm.	
C-1	CAPACITOR, fixed: paper; 2 uf ±10%; 6000 vdcw; JAN type CP70D1FP205K; spec JAN-C-25.	Plate supply filter for modulator tubes.
C-102, C-103	CAPACITOR, fixed: mica; 22,000 uuf ±10%; 600 vdcw; JAN type CM50B223K; spec JAN-C-5.	Couple amplifier-phase inverter plate to amplifier grids.
C-105, C-106	CAPACITOR, fixed: mica; 10,000 uuf ±10% 1200 vdcw; JAN type CM50B103K; spec JAN-C-5.	Couple amplifier plate to driver grids.
C-101	CAPACITOR, fixed: paper; 4 uf ±10% 100 vdcw; JAN type CP55B1EB405K; spec JAN-C-25.	Amplifier-phase inverter cathode bypass.
C-111	CAPACITOR, fixed: paper; 4 uf ±10%; 600 vdcw; JAN type CP70E1EF405K; spec JAN-C-25.	Bias supply output filter.
C-109	CAPACITOR, fixed: paper; .5 uf ±10%; 1000 vdcw; JAN type CP69B1EG504K; spec JAN-C-25.	Amplifier plate supply filter.
C-107	CAPACITOR, fixed: paper; .5 uf ±10%; 600 vdcw; JAN type CP65B1EF504K; spec JAN-C-25.	Modulator stage grid supply bypass.
C-104, C-110	CAPACITOR, fixed: paper; 1 uf ±10%; 400 vdcw; JAN type CP65B1EE105K; spec JAN-C-25.	C-104: Amplifier-phase inverter plate decoupling. C-110: Bias regulator grid filter.
C-108	CAPACITOR, fixed: paper; 4 uf ±10%; 3000 vdcw; JAN type CP70E1EL405K; spec JAN-C-25.	Rectifier filter capacitor.
C-201	CAPACITOR, fixed: paper; .5 uf ±10%; 600 vdcw; JAN type CP65B1EF504K; spec JAN-C-25.	Suppresses spark at relay 0-201 contacts.

Identification Table of Parts for Modulator Type 50H (contd)

Ref symbol	Name of part and description	Function of part
	CLAMP: cable; Army-Navy type AN-3057-24; black anodized.	
	CLEANER, ELEMENT, air: crimped screen wire; 19-1/2" x 9-9/16" x 2".	
P1	CONNECTOR, plug: 22 female rd pol cont; Army-Navy type AN-3106-36-1S.	Cabinet cable connector to amplifier deck.
P-2	CONNECTOR, plug: 35 female rd pol cont; Army-Navy type AN-3106-28-15S.	Cabinet cable connector to dialing and auxiliary relay unit.
P-3	CONNECTOR, plug: female 14 rd pol cont; straight type.	Cabinet cable connector to dialing and auxiliary relay unit.
J-101	CONNECTOR, receptacle: 22 rd male cont; pol; straight type; Army-Navy type AN-3102-36-1P.	Amplifier chassis connector.
J-202	CONNECTOR, receptacle: 35 male rd cont; pol; straight type: MIL type AN-3102-28-15P.	Dialing and auxiliary relay unit chassis connector.
J-201	CONNECTOR, receptacle: 14 rd male cont; pol; straight type.	Dialing and auxiliary relay unit chassis connector.
I-1	DIAL, telephone: nondelayed impluse type.	Generates local dial pulses when rotated.
F-3 thru F-6	FUSE, cartridge; 1 amp; 250 v; cont oper at 110% load; opens in 1 hr at 135% load.	F-3 and F-4: Bias transformer protection. F-5 and F-6: Modulator tubes filament transformer protection.
F-7 thru F-10	FUSE, cartridge: 2 amp; 250 v; cont oper at 110% load; opens in 1 hr at 135% load, in 25 sec at 200% load.	F-7 and F-8: Rectifier h-v plate transformer protection. F-9 and F-10: Rectifier and amplifier filament transformers protection.
F-1, F-2	FUSE, cartridge: 2.5 amp; 250 v; cont oper at 110% load; opens in 1 hr at 135% load; in 25 sec at 200% load.	Blower motor protection.

E-117, E-118	INSULATOR, standoff: rd post shape; white glaze ceramic; .750 lg o/a; 3/8" diam, 2 tapped #6-32 x 1/4" holes at ea end; JAN type NS4W0106.	
E-103 through E-116, E-206 through E-209	INSULATOR, standoff: cylindrical white glazed ceramic; 1/4" OD, tapped 4-40 x 1/4" dp at ea end; Centralab #X-783A, Wilcolec #27966.	
E-4 through E-13	FUSE HOLDER: extractor post type for 13/32" diam x 1-1/2" lg cartridge fuse.	
E-14 through E-19, E-101, E-102, E-202, E-204, E-205	INSULATOR, standoff: cylindrical; JAN type NS4W0308; white glaze ceramic; 1" lg; 3/4" diam, 2 tapped 10-32 x 3/8 holes at ea end.	
E-201, E-203	INSULATOR, standoff: sq post shape; JAN type NS4W1412; 1.500" lg o/a; 1.1" sq w/2 tapped 8-32 x 3/8 holes one at ea end.	
	LEAD, electrical: one .0063" x 3/8" phosphor bronze solid cond, electro tin plate .00004" min per U.S. Army spec 72-53, type II; 6-13/16" lg excluding term; Wilcolec #30777; tube cap on 1 end, 7/32" hole on other end; p/o Modulator Type 50H; Wilcolec part/dwg #96186.	
M-1	METER, audio level: JAN type MR36W123SPEC; -10 to +6 db scale; 6 mw power at 600 ohms.	Indicates AUDIO LEVEL at input to amplifier and at modulator tube grids.
M-4	METER, voltmeter: JAN type MR36W300DCVV 0-300 v DC scale.	Measures grid-bias voltage applied to modulator tubes.
M-2	METER, ammeter: JAN type MR36W156SPEC; 0 to 1 ma.	Measures plate current of either driver tube.
M-3	METER, ammeter: JAN type MR36W001DCAA 0-1 amp.	Measures modulator cathode current.
	MOTOR, AC: single ph type; 1/6 hp at 1725 rpm; 230 v 60 cyc, .7 amp, 80% pf.	

Identification Table of Parts for Modulator Type 50H (contd)

Ref symbol	Name of part and description	Function of part
L-1	REACTOR: filter choke; 1.5 hy at 1.6 amp DC; DC resistance not over 50 ohms; 4500 vdcw; HS metal case; ADC #A6976; Wilcolec part #838011.	Plate supply filter for modulator tubes.
L-101	REACTOR: filter choke; 10 hy at 150 ma DC;DC resistance 300 ohms; insulation 2500 vdcw; HS metal case; ADC #A6975; Wilcolec part #838012,	Filters output of modulator rectifier.
CR-201	RECTIFIER, metallic: selenium; input 10-66 v AC, 60 cps; output 5-55 v DC, max cur .20 amp DC; o/a dimen 2-7/8" lg x 1" wd x 1-1/4" h; #10-32 stud mtg; 25% duty cycle; Wemco #1A43HA1; Wilcolec part #46011.	Dialing pulse rectifier.
0-101	RELAY, armature: DPST normally open; cont 5 amp, 220 v AC, coil cur rating .058 amp max, 3300 ohms, 25 v DC; solder lug term on coil and cont; type II; Phillips Control #2MS10B1; Wilcolec part #11780.	Bias protective relay. Opens primary circuit of T-103 modulator filament transformer if bias supply fails.
0-208, 0-209	RELAY, armature: SPDT, 8.1 v oper, 6.4 v release .270 ma, 30-ohm D-C resistance.	Switches hv from selector Power Unit Model 36D to modulation transformer.
	COIL, relay: actuates vacuum switch.	Actuates 0-208 and 0-209 contacts.
0-202	RELAY, armature: 1C cont; cont rating 1 amp, 50 w noninductive; #18 ga silver cont; coil single wnd, 125 ohms, oper cur .055 amp, 8 v max; term solder lugs on coil and cont; slow release; Phillips Control #2SR46A1; Wilcolec part #11778.	Transfers dialing phase to function relay and remains closed for entire series of pulses, keeping 0-203 closed for same interval.
0-203	RELAY, armature: cont arrangement 1A, 1B. 2C; cont rating 1 amp 50 W noninductive; 9 silver cont and 3 platinum iridium; single wnd coil 200 ohms dc resistance, .036 amp, cont; Phillips Control #2QA371A1; Wilcolec part #11777.	Dialing function relay completes circuit for dialing pulses to stepping relay.
0-204	RELAY, armature: cont 1E, 1C; cont #18 ga silver, cont rating 1 amp, 50 w noninductive; single wnd coil 200 ohms dc resistance, .036 amp, 8v dc max; term solder lugs on coil and cont; Phillips Control #2QA3401A; Wilcolec part #11759.	Homing relay completes -12-volt d-c circuit from bank 5 to coil of K-201 stepping relay.

0-206	RELAY, armature: 1A cont; cont 3/32" diam silver cont, cont 12 v DC, 1-10 amp; single wnd coil, 360 ohms dc resistance, 230 vac, 60 cps, .050 amp; term solder lugs on coil and cont; Phillips Control #2AC85A1; Wilcolec part #11779.	Blower interlock completes circuit to modulator control relay 0-205.
0-205	RELAY, armature: cont 3 A; 3 amp, 220 v AC cont; coil 12 v DC .114 amp nominal and 2 amp max oper cur; coil and cont solder lug term; Phillips Control #A27QA26G1; Wilcolec part #11782.	Modulator control relay completes circuits to modulator tube filament transformer, shorts out R-202, and grounds center tap of T-103 through 0-207 coil.
0-207	RELAY, armature: DPDT; double coil, 70 ohms, 12 v; 7.5 v DC oper, release at 75% of oper v.	Modulator overload opens interlock circuit to Power Unit Model 36D.
0-201	RELAY, armature: pulse sensitive; SPDT; cont rating 5 amp at 115 v AC; coil 5 vdc max oper, .012 amp oper cur; 400 ohms dc resistance; solder lug and screw term on coil and cont; Adv Elec #1200; Wilcolec part #11781.	Dial pulsing. Alternately makes and breaks -12-volt circuit to coil of 0-202 and to coil of K-201 through contacts of 0-203 and 0-204.
K-201	RELAY, stepping: 5 pole 26 pos w/cam oper 1A1B1C cont and silver pl sw cont; coils 10 v DC min and 15 v DC max, 1.2 amp cur rating; solder lug term on coil and cont, coil resistance 10 ohms; Clare #A45996; Wilcolec part #10288.	Selects rectifier power unit and transmitter to be modulated. Bank or level 1 connects -12 volts from selected transmitter to modulator control relay. Bank 2 connects selected channel relay in rectifier power unit to -12 volts. Bank 3 connects -12 volts to rectifier selector relay 0-208 or 0-209. Bank 4 connects -12 volts from release transmitter to 0-204 coil. Bank 5 connects -12 volts to K-201 coil through 0-204 contacts and opens this circuit on "home" position.
R-113, R-114, R-115, R-116, R-119, R-121	RESISTOR, fixed: comp; 100,000 ohms ±10%; 2 w; JAN type RC42BF104K; per JAN-R-11.	R-113 through R-116: Amplifier plate load. R-119 and R-121: Audio level meter circuit voltage dividers

Identification Table of Parts for Modulator Type 50H (contd)

Ref symbol	Name of part and description	Function of part
R-136	RESISTOR, fixed: comp; 8200 ohms ±10%; 2 w; JAN type RC42BF822K; per JAN-R-11.	Cathode bias and bias isolator.
R-130, R-131, R-132	RESISTOR, fixed: comp; 6800 ohms ±10%; 2 w; JAN type RC42BF682K; per JAN-R-11.	Bias protective relay dropping resistors and voltage dividers.
R-102	RESISTOR, fixed: comp; 2700 ohms 10±%; 1 w; JAN type RC30BF272K; per JAN-R-11.	Amplifier-phase inverter, cathode bias resistor.
R-112	RESISTOR, fixed: comp; 1 meg ±10%; 2 w; JAN type RC42BF105K; per JAN-R-11.	Amplifier screen voltage divider.
R-110, R-137	RESISTOR, fixed: Comp; 2200 ohms ±10%; 1 w; JAN type RC30BF222K; per JAN-R-11.	R-110: Amplifier cathode bias. R-137: Parasitic suppressor V-113.
R-103, R-104, R-109, R-111, R-134	RESISTOR, fixed: comp; 100,000 ohms ±10%; 1 w; JAN type RC30BF104K; per JAN-R-11.	R-103 and R-104: Amplifier-phase inverter plate load. R-109: First amplifier plate supply decoupling resistor. R-111: Amplifier screen voltage divider. R-134: Bias regulator grid filter.
R-135	RESISTOR, fixed: comp; 150,000 ohms ±10%; 1 w; JAN type RC30BF154K; per JAN-R-11.	Bias regulator grid filter.
R-105, R-106, R-107, R-108, R-117, R-118	RESISTOR, fixed: comp; 470,000 ohms ±10%; 1 w; JAN type RC30BF474K; per JAN-R-11.	R-105 and R-106: Amplifier phase inverter voltage divider. R-107 and R-108: Amplifier grid resistors. R-117 to R-118: Driver grid resistors.
R-201	RESISTOR, fixed: comp; 150 ohms ±10%; 1 w; JAN type RC30BF151K; per JAN-R-11.	Spark suppressor for 0-201.
R-1, R-2	RESISTOR, fixed: WW; 80,000 ohms ±5%; 90 w at 200° C; JAN type RW45JH803; per JAN-R-26A.	Plate supply bleeder for modulator tubes.
R-124	RESISTOR, fixed: WW; 2000 ohms ±5%; 63 w at 275° C; JAN type RW24G202; per JAN-R26A; Wilcolec part #857008.	Driver cathode bias.

R-125 thru R-128	RESISTOR, fixed: WW; 20,000 ohms ±5%; 63 w at 275°C; JAN type RW24G203; per JAN-R-26A	Rectifier voltage divider network.
R-202	RESISTOR, fixed: WW; 5000 ohms ±5%; 22 w at 275°C; JAN type RW21G502; per JAN-R26A.	Modulator protective bias.
R-122, R-123	RESISTOR, fixed: precision; WW; 1.010 ohms ±1%; 1/2 w at 105°C; JAN type RB12B1R010F; per JAN-R-93.	Driver cathode meter shunt.
R-101	RESISTOR, variable: WW; 500 ohms ±10%; 2 w; JAN type RA20A1SA501CK; per JAN-R-19.	Audio input gain control to V-101 amplifier- phase inverter grid.
R-138	RESISTOR, variable: WW; 25 ohms ±10%; 25 w; JAN type RP101SA250KK; per JAN-R-22.	Overload relay adjustment.
R-120, R-133	RESISTOR, variable: WW; 10,000 ohms ±10%; 2 wl JAN type RA20A1SA103AK; per JAN-R-19.	R-120: Audio level meter shunt adjuster. R-133: Modulator bias output adjustor.
R-129	RESISTOR, variable: WW; 2500 ohms ±10%; 2 w; JAN type RA20A1SA252AK; per JAN-R-19.	Bias protective relay 0-101 adjustor.
X-101	SOCKET, tube; 9 cont naval; one piece saddle mtg; JAN type TSE9T101 per JAN-S-28A.	
X-102, X-103, X-113	SOCKET, tube: 5 cont mod; retainer ring mtg; two 3/16" x 7/32" mtg slots on 1-11/16" ctr; round ceramic body 1-1/4" diam x 5/8" h; Amphenol #49RSS5M; Wilcolec part #29813.	
X-108, X-109, X-110, X-111, X-112	SOCKET: tube: octal; 1 piece saddle mtg; JAN type TSB8T101.	
X-104, X-105, X-106, X-107	SOCKET, tube: 4 cont jumbo; below chassis base mtg.	

Identification Table of Parts for Modulator Type 50H (contd)

Ref symbol	Name of part and description	Function of part
S-3, S-4, S-5	SWITCH: interlock; SPST; 10 amp, 220 v; 2 piece; Navy type #24067 and 24067A.	Personnel protection switch which opens interlock 220-volts a-c input power circuit when door or back is opened or removed.
S-201	SWITCH, toggle: DPDT: JAN type ST52N; per JAN-S-23.	Converts dialing line input circuit to SIMPLEX or PARALLEL type of remote control dialing line.
S-1	SWITCH, toggle: DPDT: JAN type ST52S; per JAN-S-23.	Connects AUDIO LEVEL meter to input audio line or grid circuit of modulator tube.
S-2	SWITCH, toggle: SPDT: JAN type ST42G; per JAN-S-23.	Connects driver amplifier meter to cathode circuit of either driver tube.
T-101	TRANSFORMER, AF: plate coupling type; pri impedance 58,000 ohms, CT, sec 14,500 ohms, split wnd; turns ratio pri to sec 2 to 1; freq response 400 to 3000 cps ±1/2 db; HS metal case; ADC #A6969; Wilcolec #840009.	Couples signal from driver plates to modulator grids.
T-201	TRANSFORMER, AF: line type pri impedance 50, 125, and 500 ohms, balanced and ct; sec impedance 500 ohms; HS metal case; freq response ±1/2 db from 400 to 3000 cps, not over -3 db down at 60 cps; electrostatic shield between pri and secd; 10 solder lug term on bottom; ADC #A6968; Wilcolec part #840008.	Couples input audio signal to V-101 grid and isolates dialing pulses from V-101 grids.
T-1	TRANSFORMER, AF: modulation type; pri impedance 15,800 ohms plate to plate; 700 ma dc max pri cur, .9 amp at 4500 ohm tap, .535 amp at 7500 ohm tap; max oper level 1800 w; HS metal case; turns ratio pri to 7500 ohm sec 1.87:1; response ±1/2 db from 400 to 3000 cps; ADC #A6977A; Wilcolec part #840010.	Modulates selected transmitter final amplifier plate voltage and matches modulator plate circuit to plate circuit load of final amplifier tubes in transmitter.
T-106	TRANSFORMER, power: pri 0/210/220/230/240 v 60 cps; 3 secd wnd; secd #1-420 v at .02 amp CT; secd #2, -5.0 v at 2.0 amp CT; secd #3, 6.3 v a 1.0 amp CT; HS metal case, ADC #A6973; Wilcolec part #842019.	Bias supply plate and filament power transformer.

T-103	TRANSFORMER, power: fil type pri 0/210/220/230/240 v AC, 60 cps; secd 7.5 v at 24 amp CT; HS metal case; ADC #6971; Wilcolec part #842017.	Supplies filament power for modulator tubes.
T-102	TRANSFORMER, power: fil type pri 0/210/220/230/240 v AC, 60 cps; secd #1, 6.3 v at 3.0 amp CT; secd #2, 10.0 v at 3.25 amp CT; secd #3, 10.0 v at 3.25 amp CT; HS metal case; ADC #A6970; Wilcolec part #842016.	Supplies filament power to amplifier-phase inverter, amplifier and driver tubes.
T-104	TRANSFORMER, power: Plate type pri 0/210/220/230/240 v AC, 60 cps; secd 1650 v at .150 amp DC; ins 4250 v RMS test; HS metal case; ADC #6974; Wilcolec part #842020.	Supplies hv for bridge rectifier tubes V-108 through V-111.
T-105	TRANSFORMER, power: fil type; pri 0/210/220/230/240 v AC, 60 cps; secd #1, 5 v at 4.0 amp CT; secd #2, 5 v at 2.0 amp CT; secd #3, 5 v at 2.0 amp CT; all secd wnd ins for 2500 v peak working; HS metal case; ADC #A6972; Wilcolec part #842018.	Supplies filament power for bridge rectifier tubes V-108 through V-111.
V-101	TUBE, electron: JAN-12AU7.	First audio amplifier and phase inverter.
V-102, V-103, V-113	TUBE, electron: JAN-807.	V-102 and V-103: Second audio amplifier. V-113: Bias output regulator.
V-104, V-105	TUBE, electron: JAN-845W.	Modulator driver stage.
V-106, V-107	TUBE, electron: JAN-450TL.	Modulator final stage.
V-108 through V-111	TUBE, electron: JAN-5R4WGY.	Amplifier plate supply full-wave rectifier.
V-112	TUBE, electron: JAN-5Y3GT.	Bias voltage rectifier.

APPENDIX II.
WIRE LIST FOR INTERCONNECTION DIAGRAM

The wiring list is found on pages 143 through 152 of Radio Transmitter Model 96D instruction book. Refer to interconnection wiring diagram, figure 38, for small layout showing complete 10-channel station with all units designated (TV, TIV, - - - RI, M, RII, TVI, etc.) for use with column 1 references in wire list. Columns 1 and 2 references are to characters appearing on chassis, terminal boards, etc. Modulator leads all appear on other sheets.

Columns 7 and 8 show lugs to be applied to ends of leads. Lugs are packaged by types with part number appearing on each package.

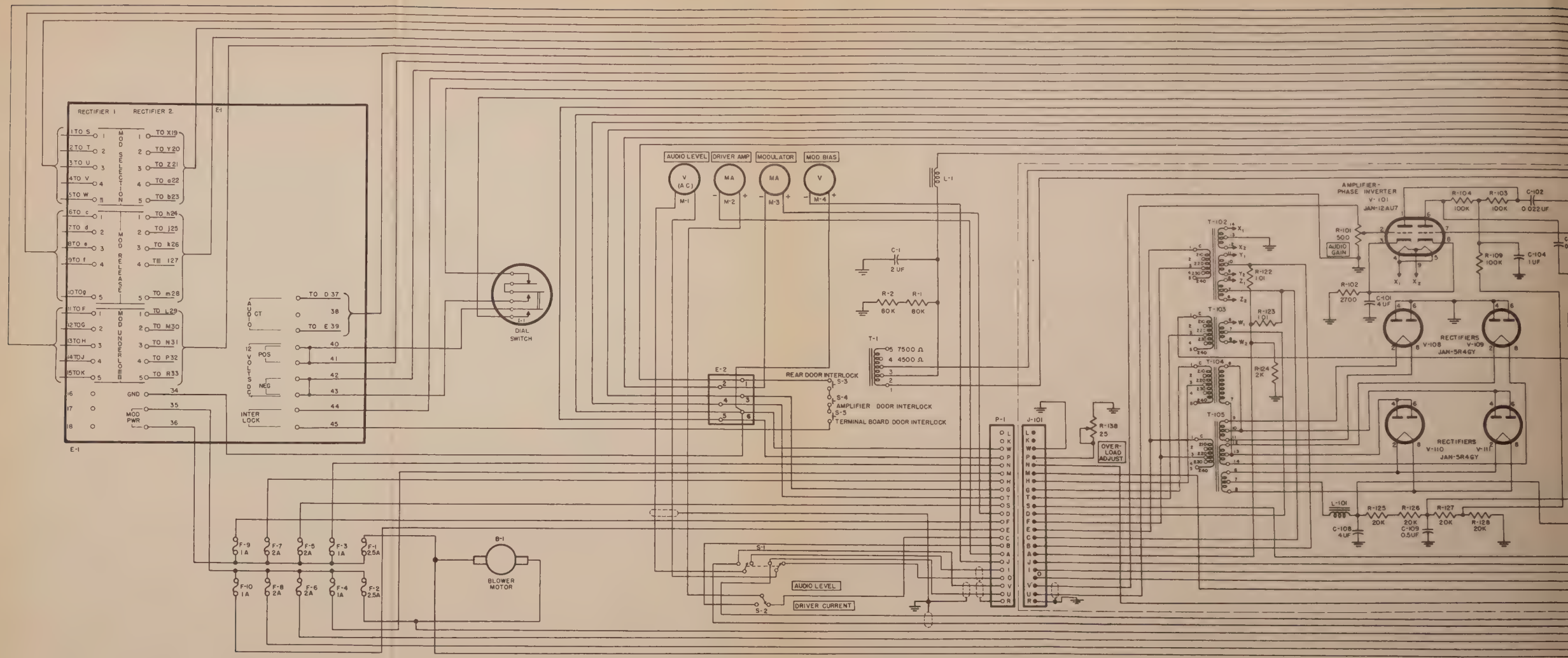
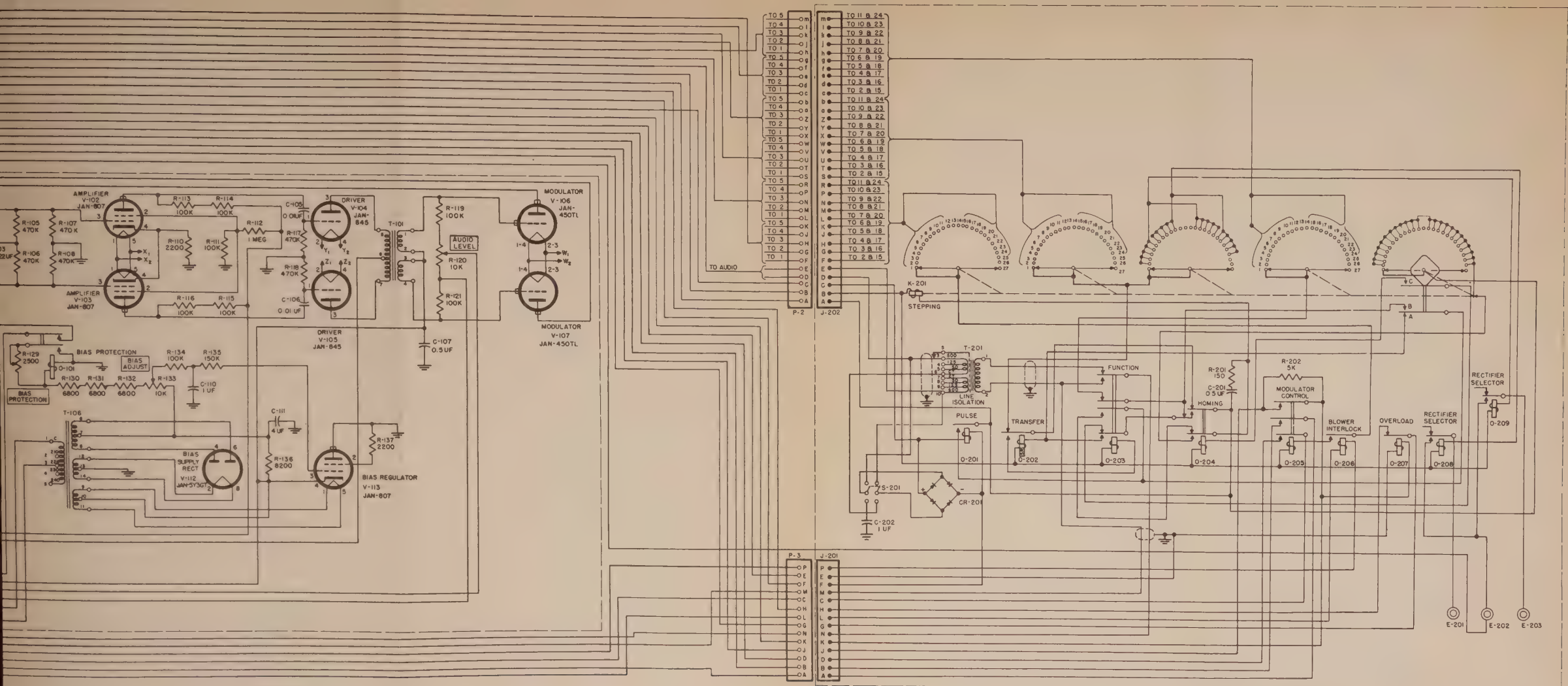


Figure 37. Modulator Typ



50H, schematic diagram

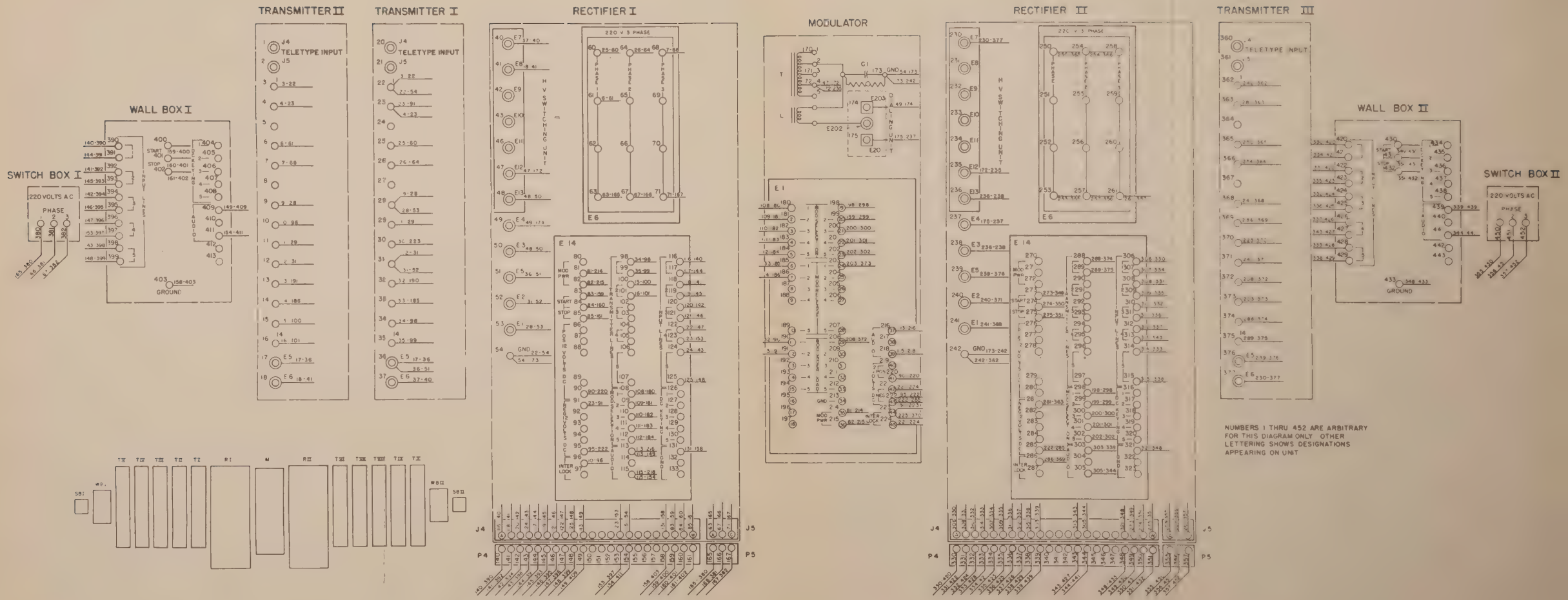
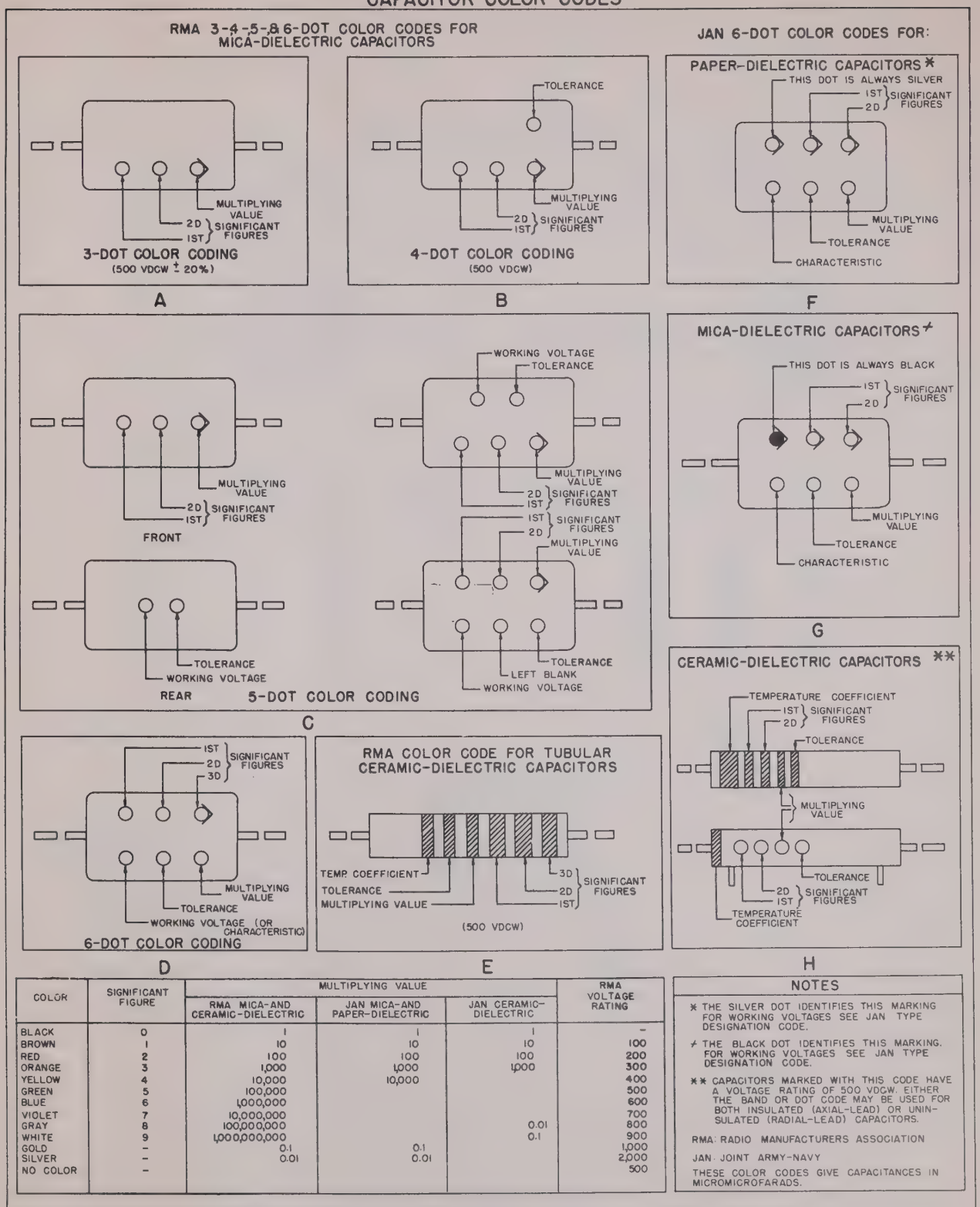


Figure 38. Interconnection wiring diagram

CAPACITOR COLOR CODES



COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE			RMA VOLTAGE RATING
		RMA MICA-AND CERAMIC-DIELECTRIC	JAN MICA-AND PAPER-DIELECTRIC	JAN CERAMIC-DIELECTRIC	
BLACK	0	1	1	1	-
BROWN	1	10	10	10	100
RED	2	100	100	100	200
ORANGE	3	1,000	1,000	1,000	300
YELLOW	4	10,000	10,000		400
GREEN	5	100,000			500
BLUE	6	1,000,000			600
VIOLET	7	10,000,000			700
GRAY	8	100,000,000		0.01	800
WHITE	9	1,000,000,000		0.1	900
GOLD	-	0.1	0.1		1,000
SILVER	-	0.01	0.01		2,000
NO COLOR	-				500

NOTES

* THE SILVER DOT IDENTIFIES THIS MARKING FOR WORKING VOLTAGES SEE JAN TYPE DESIGNATION CODE.

✓ THE BLACK DOT IDENTIFIES THIS MARKING. FOR WORKING VOLTAGES SEE JAN TYPE DESIGNATION CODE.

** CAPACITORS MARKED WITH THIS CODE HAVE A VOLTAGE RATING OF 500 VDCW. EITHER THE BAND OR DOT CODE MAY BE USED FOR BOTH INSULATED (AXIAL-LEAD) OR UNINSULATED (RADIAL-LEAD) CAPACITORS.

RMA: RADIO MANUFACTURERS ASSOCIATION

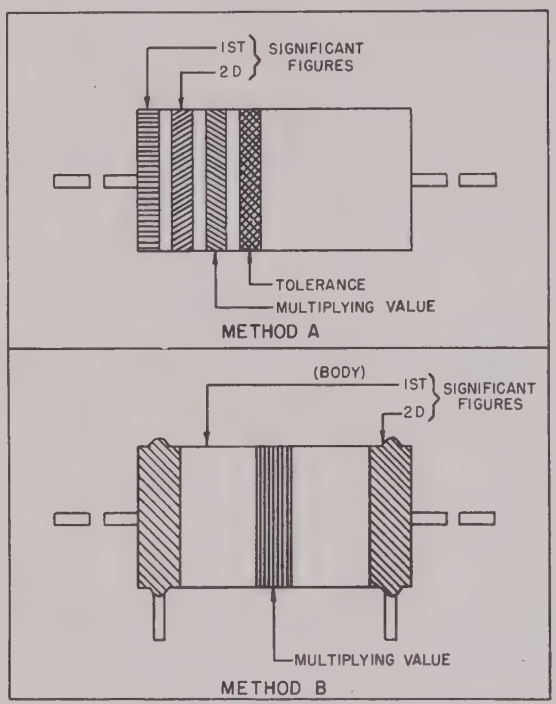
JAN: JOINT ARMY-NAVY

THESE COLOR CODES GIVE CAPACITANCES IN MICROMICROFARADS.

Figure 39. Capacitor color codes

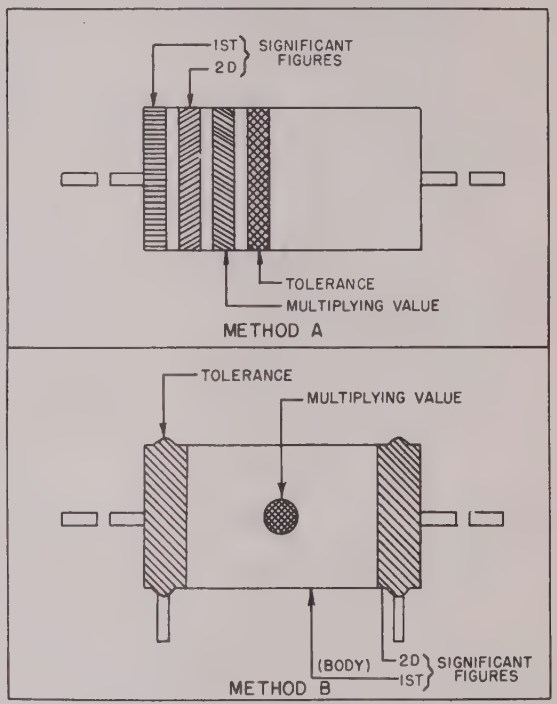
RESISTOR COLOR CODES

RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS*



A

JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS≠



B

COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE	TOLERANCE (%)
BLACK	0	1	± –
BROWN	1	10	± 1
RED	2	100	± 2
ORANGE	3	1,000	± 3
YELLOW	4	10,000	± 4
GREEN	5	100,000	± 5
BLUE	6	1,000,000	± 6
VIOLET	7	10,000,000	± 7
GRAY	8	100,000,000	± 8
WHITE	9	1,000,000,000	± 9
GOLD	–	0.1	± 5
SILVER	–	0.01	± 10
NO COLOR	–	–	± 20

NOTES

* INSULATED FIXED COMPOSITION RESISTORS WITH AXIAL LEADS ARE DESIGNATED BY A NATURAL TAN BACKGROUND COLOR. NON-INSULATED FIXED COMPOSITION RESISTORS WITH AXIAL LEADS ARE DESIGNATED BY A BLACK BACKGROUND.

≠ RESISTORS WITH AXIAL LEADS ARE INSULATED. RESISTORS WITH RADIAL LEADS ARE NON-INSULATED.

RMA: RADIO MANUFACTURERS ASSOCIATION

JAN: JOINT ARMY-NAVY

THESE COLOR CODES GIVE ALL RESISTANCE VALUES IN OHMS.

Figure 40. Resistor color codes

SUPPLEMENTAL INSTRUCTIONS

for

50H1 MODULATOR

Manufactured by
WILCOX ELECTRIC COMPANY, INC.
Kansas City 1, Mo., U. S. A.

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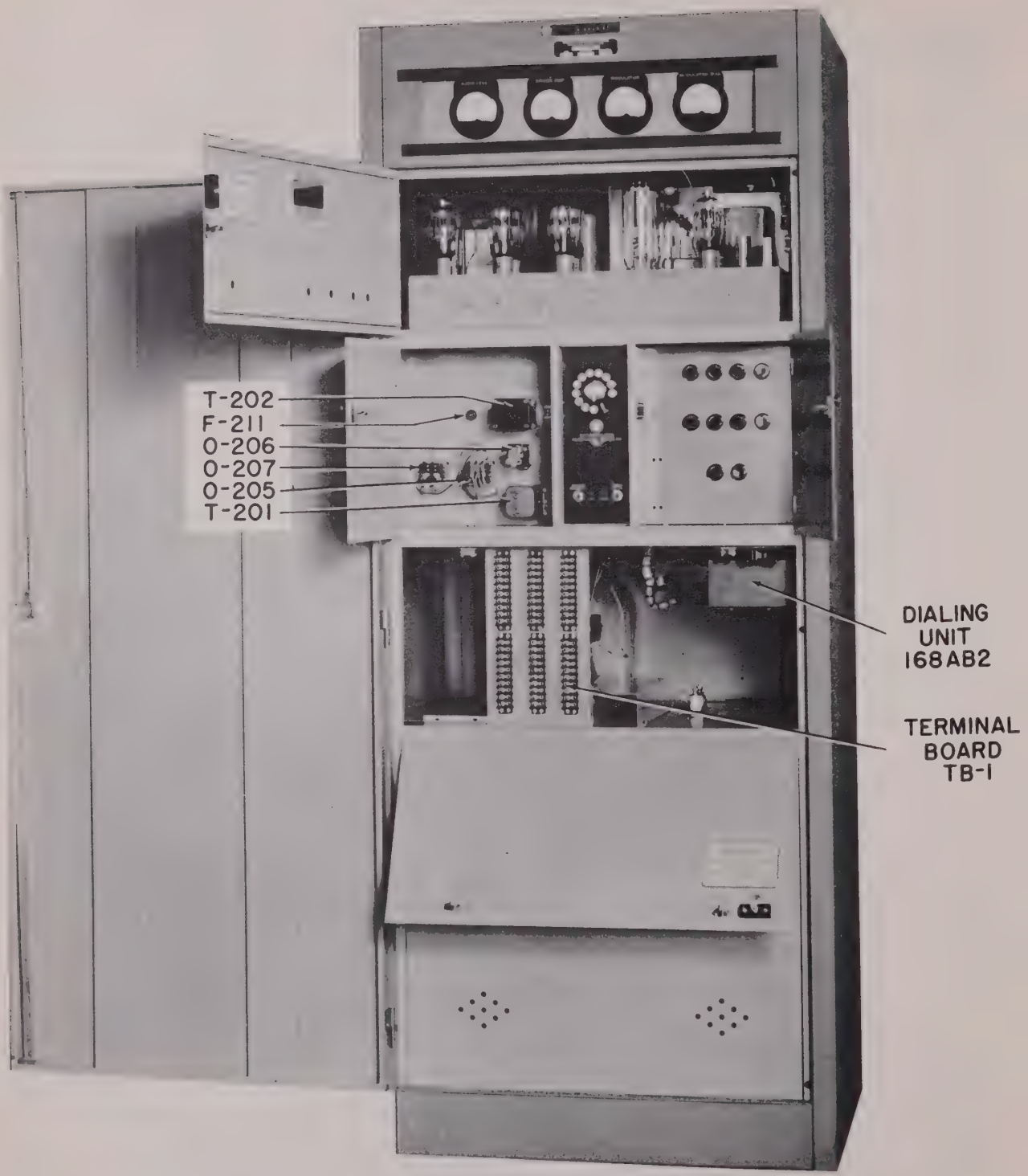


Figure No. 1. Modulator Type 50H1, front view.

SUPPLEMENTAL INSTRUCTIONS

FOR

WILCOX MODULATOR TYPE 50H1

Section I. INTRODUCTION

1. General

Modulator Type 50H1 (figure 1) is the Wilcox Electric Co. designation for a modulator unit similar to Type 50H, described in the instruction manual to which the following instructions are supplementary. The basic amplifier circuits are identical; the prime difference between the two units is in the associated transmitter control circuits. In appearance and construction, Modulator Type 50H1 is similar, not only to Modulator Type 50H but, to earlier models of the same class of equipment. It may therefore be added to existing installations without extensive wiring changes and without alteration in overall appearance.

2. Circuit Differences

a. The unit type of construction of Wilcox equipment (series 96 Transmitters, series 36 Rectifiers and series 50 Modulators) requires centralization of control circuits within one of the units. Prior to the introduction of Modulator Type 50H1, control circuits were centered and made available within the Rectifier unit. Space and other considerations, however, have made it convenient to expand control functions by centralizing same in the type 50H1 Modulator. The latter is equipped with a large terminal board to facilitate the following control connections: channel selection, carrier control, modulator control for up to 8 R-F channels, start and stop control for the series 36 Rectifier units, and other special control functions to the limit of terminal board and equipment capacity.

b. Modulator 50H1 is designed for the following types of control:

(1) Straight dial control with Wilcox Control Console Type CS380, or similar equipment, as described in Section II.

(2) Direct multiple line and switch control, described in Section III.

(3) Combination dial and multiple line control with Remote Control Console Type CS212, as described in Section IV.

c. When a Wilcox series 50 Modulator is used in conjunction with Rectifier Units Type 36A or 36A5, a high voltage filter is required in the Modulator. This filter is shown in the instruction book to which this supplement is attached, pages 6 and 57, figures 6 and 31 respectively. The filter, consisting of capacitor C-1 and reactor L-1, is not required when the Modulator is used with a Type 36A4, a Type 36D or a Type 36D1 Rectifier Power Unit since a high voltage filter is incorporated in each 36A4, 36D and 36D1 Rectifier. Modulator 50H1 is normally supplied without the high voltage filter as shown in figure 2 of this supplement.

Section II. DIAL CONTROL

3. General

When it is desired to control a multichannel transmitter from a remote control point, it is usually found that the cost of a multiple line and switch control system is prohibitive. For this reason, the preferred method is to employ dial control, utilizing

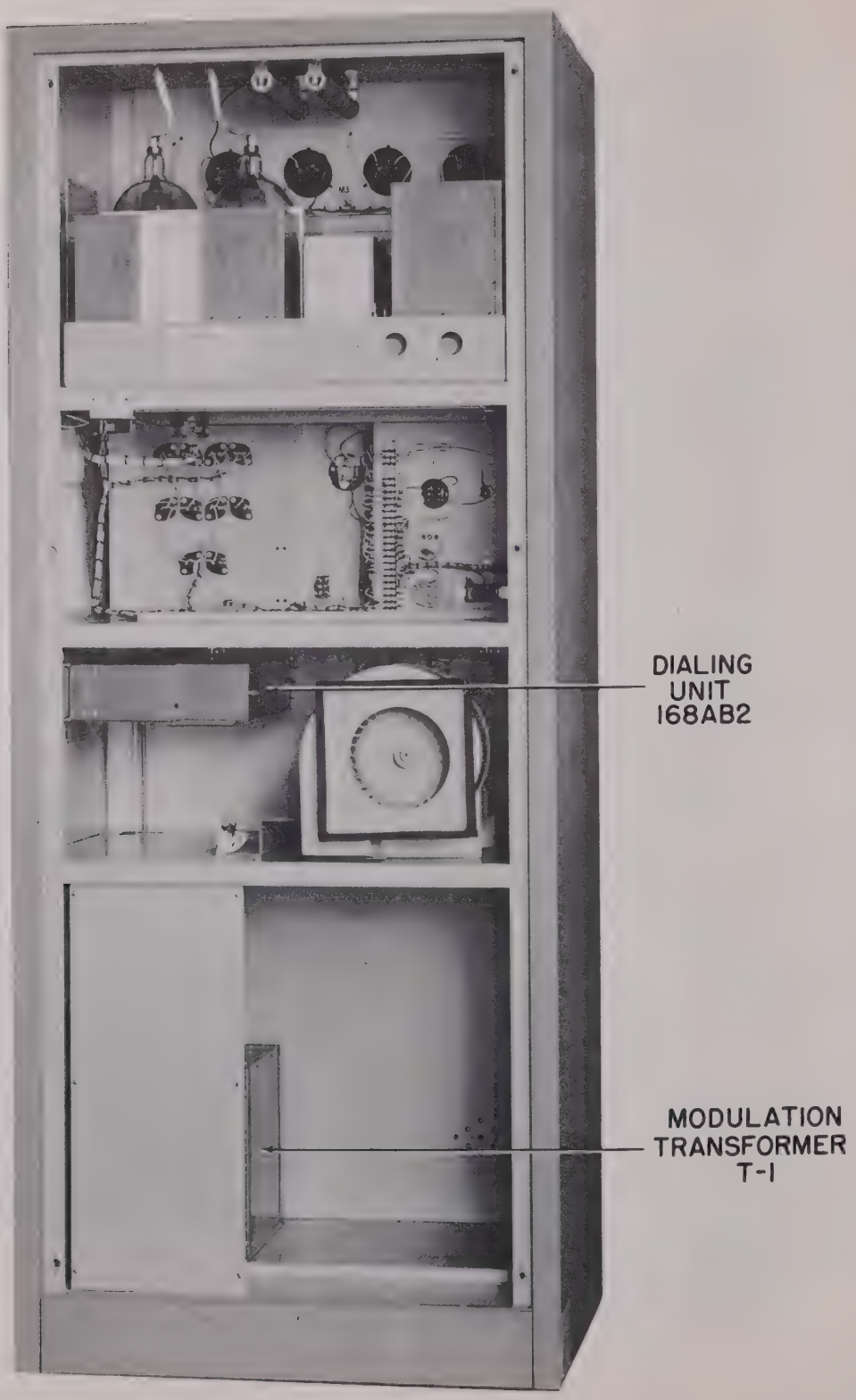


Figure No. 2. Modulator Type 50H1, rear view.

for the purpose a line leased from the local telephone company. In the dial control system, dial pulses and voice signals are transmitted over the same line. Carrier control is accomplished by means of a simplex circuit, using the earth as a direct current return for the keying relays. The keying relays used in series 96 Transmitters are extremely sensitive and satisfactory keying (carrier control) may be obtained over distances of from 15 to 20 miles.

4. Operator's Equipment

a. The operator's equipment for dial control is less costly than the equipment required for any other type control system. The dial required is similar in appearance to a telephone dial; however, the arrangement of contacts is slightly different. Alternating current, used for dial voltage supply, may be obtained from a 1-to-1 transformer direct from any 110-volt a-c source.

b. A telegraph key, a microphone equipped with a push-to-talk switch, and a speech amplifier complete the operator's equipment when the dial control system is utilized. The speech amplifier must be capable of supplying a signal level of not less than -15 db at the transmitter. The output of the speech amplifier should be carried through the normally closed contacts of the selector dial so that amplifier output will be cut off from the line while dialing. The push-to-talk switch on the microphone is connected between the secondary center tap of the speech amplifier output transformer and an earth ground or the metallic system ground if the latter is provided.

c. Wilcox Control Console Type CS380 provides the control functions described in the preceding two paragraphs.

5. Transmitter Equipment

a. When the dial control system is used, a Wilcox Type 168AB2 Dialing Unit is required in Modulator Type 50H1. The dialing unit is mounted in the modulator cabinet in the position shown in figure 2. The dialing unit is also shown in figures 3, 4 and 5.

b. Dialing Unit Type 168AB2 consists basically of a 3-level, 10-point stepping relay, K-301. As shown in schematic diagram, figure 11, the various control circuits are terminated in two multicontact receptacles, J-301 and J-302, located on the back of the unit. Cable plugs P-2 and P-3 (figure 11) are provided in the modulator cabinet assembly primarily for connection to the type 168AB2 Dialing Unit. However, in order to provide a modulator of utmost versality, cable connections for plugs P-2 and P-3 are all brought out to independent terminals on the main terminal board, TB-1 in figure 11. By making a few simple strap connections on the main terminal board, Modulator 50H1 may be used not only with Dialing Unit 168AB2 but with the other types of control systems to be described in subsequent sections. Strap connections for each system are shown in the schematic diagram, figure 11.

c. Analysis of the schematic diagram will show that pins 4 thru 33 of plug P-2 are connected to terminals 1 thru 30 of main terminal board TB-1. These terminals correspond to the 10 steps of each of the three levels of stepping relay K-301. It is customary to use the first level of relay K-301 (terminals 1 thru 10 of TB-1) for transmitter channel control, the second level (terminals 11 thru 20) for transmitter carrier control, and the third level (terminals 21 thru 30) for modulator control.

(1) Terminals 1, 2 and 3 of plug P-2 correspond to the moving contacts of the three levels of the stepping relay and are strapped at terminal board TB-1 to complete the required circuits. Pin 1 of plug P-2 is connected to terminal 41 and strapped to terminal 37; from terminal 37 to pin 7 of plug P-3, through the normally closed contacts of relay 0-301, back through pin 6 of plug P-3 to terminal 36 of TB-1 where the connection is strapped to terminal 34 and to ground terminal 60. Relay 0-301 is closed during the entire stepping operation, with-holding the ground from any of the channel control terminals until the stepping relay comes to rest.

(2) Pin 2 of plug P-2 is connected to terminal 42 of terminal board TB-1 where it is connected by jumper to terminal

Figure No. 3. Dialing Unit Type 168AB2, rear view.

52 and, through terminal 18 of terminal strip E-204, to the primary center tap of line isolation transformer T-201. Carrier control of the selected channel is accomplished by grounding the output center tap of a similar line isolation transformer at the operator's position. A continuous metallic telephone line is required in this type of carrier control (keying).

(3) Pin 3 of plug P-2 is permanently connected to terminal 43 of terminal board TB-1 and strapped to terminal 54 which, when connected to negative 12 volts, operates the modulator control relay 0-205 through the contacts of blower interlock relay 0-206. When a transmitter channel is selected, level 3 of the stepping relay completes the circuit from relay 0-205 to the contacts of the underload relay in the particular transmitter (channel) selected. The underload relay is carrier operated and applies the required negative voltage to modulator relay 0-205 only when the transmitter carrier is on, thus protecting the modulator against operation with no load.

(4) When an unattended transmitter is operated from a distant control point, it is required that the operator be able to disable the transmitter from his control position. For this purpose, Rectifier Power Unit 36D1 is equipped with START and STOP relays which can be selected by the selector dial at the remote control point. Dial digits "9" and "10" are usually reserved for this purpose, corresponding with positions 9 and 10 of stepping relay K-301 (level 1) and terminals 9 and 10 of main terminal board TB-1. Negative 12 volts at terminal 59 of terminal board TB-1 is grounded by strap connection between terminals 59 and 60. This is shown by a dotted line in schematic diagram, figure 11.

(5) Modulator test dial I-1, located on the front of Modulator 50H1, is used to test the selector mechanism at the transmitter location. The test dial is connected in the secondary of local dialing transformer T-202 and delivers 60-cycle dialing pulses of approximately 30-volts to the line terminals of Dialing Unit Type 168AB2.

Caution: Do not operate test dial I-1 at any time while a transmitter carrier is on. The local dialing voltage would, in this case, be applied directly to the modulator input and some damage might result despite the protection offered by spark gap mounted on the terminals of modulation transformer T-1.

(6) The telephone line between the remote control point and the transmitter is connected to terminals 51 and 53 of terminal board TB-1. These terminals are internally connected to the primary of transformer T-201 and strapped to terminals 31 and 32, and 48 and 49, the strap connections permitting the same telephone line to be used for speech as

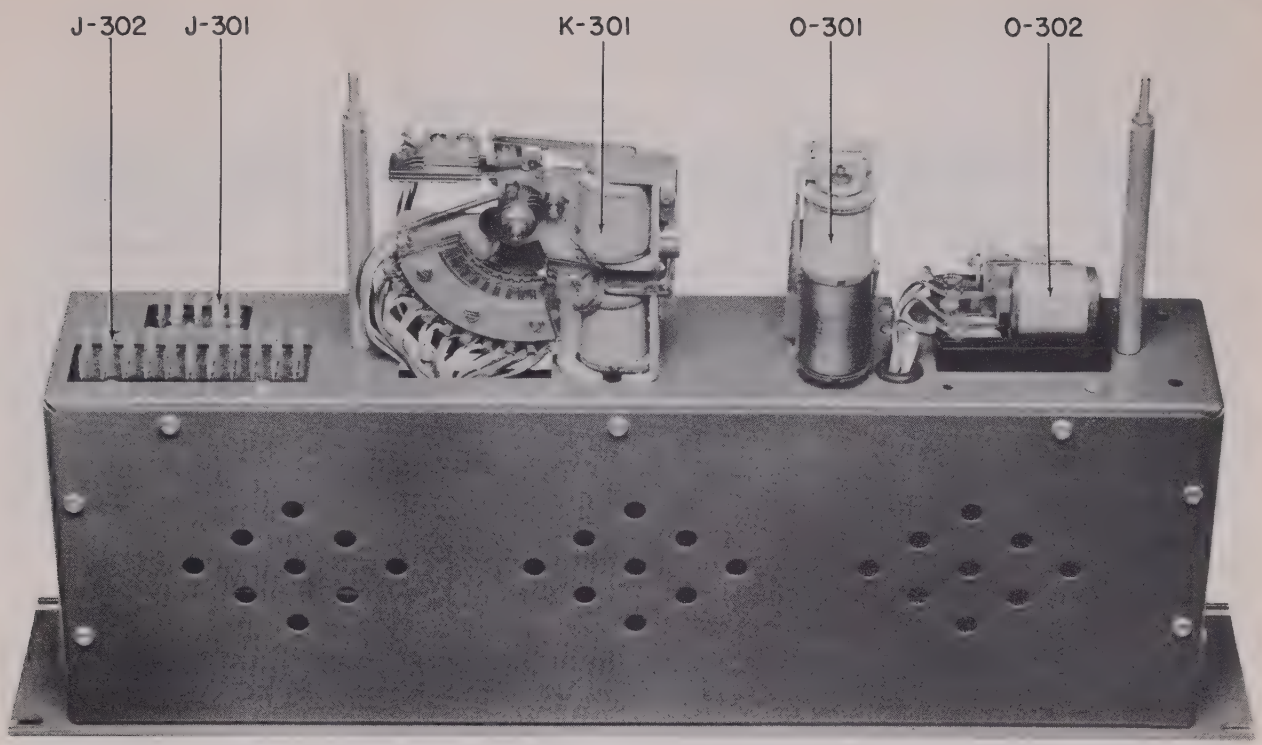


Figure No. 4. Dialing Unit Type 168AB2, dust cover removed.

well as control selection. Dialing pulse rectifier CR-301 in the type 168AB2 Dialing Unit presents a very high impedance to the speech frequencies, except when 10-volts or more is applied, and no noticeable loading effect is experienced due to the Dialing Unit being connected across the line.

6. Circuit Theory, Dialing Unit Type 168AB2

a. The Type 168AB2 Dialing Unit is assembled on a steel chassis, mounted on a standard relay rack panel 3-1/2" high x 19" in width. The assembly is shown in figures 3, 4 and 5. All control circuits are terminated in two multi-contact receptacles, J-301 and J-302.

b. The Dialing Unit contains a 3-level, 10-point stepping relay K-301, dialing pulse rectifier CR-301, function relay 0-301, dialing pulse relay 0-302 and a contact spark suppressor consisting of resistor R-301 and capacitor C-301. Operation of the unit is covered in the following paragraphs.

c. A dial and dialing voltage transformer, at the remotely located operator's position, are used to send a series of a-c pulses over the telephone line. The incoming pulses are applied to pins 1 and 2 of receptacle J-201. The dial used to control Dialing Unit 168AB2 differs from a standard telephone dial in that the initial pulse is supplied by the cocking operation. The initial pulse is therefore considerably longer in duration than subsequent pulses since it starts the instant the dial is moved from its 'at rest' position and continues until the dial is released. A number of operations take place during the first pulse, in the following sequence:

(1) The pulse is rectified by the full-wave bridge rectifier CR-301 and closes pulse relay 0-302.

(2) The closed contacts of 0-302 connect pin 3 of receptacle J-301 (positive 12-volts) to the release coil of stepping relay K-301 through the normally closed contacts of function relay 0-301, homing the stepping relay.

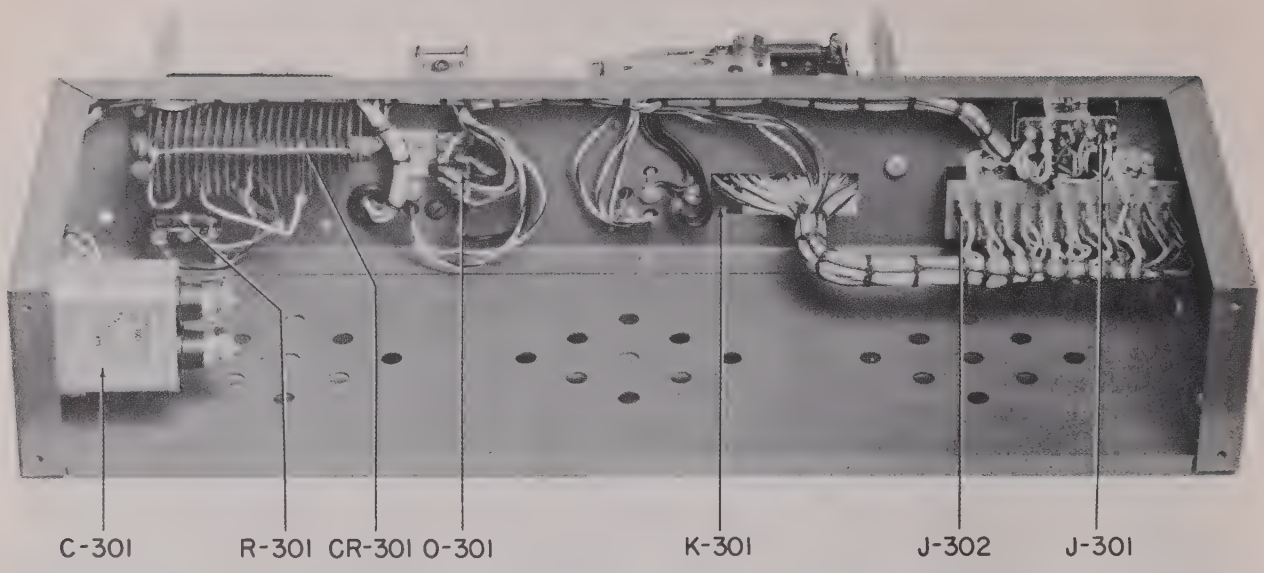


Figure No. 5. Dialing Unit Type 168AB2, interior view.

(3) When the stepping relay reaches 'home', the normally open contacts of the OFF-NORMAL switch are closed mechanically, connecting the moving contact of pulse relay 0-302 to one side of the STEP coil in K-301 and to one side of the coil in function relay 0-301, applying positive 12-volts to 0-301. The opposite side of the coil in function relay 0-301 is connected, through pin 4 of receptacle J-301, to negative 12-volts and relay 0-301 closes.

(4) When relay 0-301 closes, its second set of normally open contacts connect the opposite side of the STEP coil to pin 6 of receptacle J-301. Since this pin is externally connected to negative 12-volts, the STEP coil is energized and stepping relay K-301 moves to position 1. At the same instant, a parallel circuit is closed by the first set of normally open contacts in function relay 0-301, by-passing the OFF-NORMAL switch contacts which open at the first step.

(5) Function relay 0-301 is a slow release relay. When the selector dial is released, the slow release coil holds 0-301 closed until the next pulse is received. This holding action permits the stepping relay to advance an additional step as each pulse is received, stopping at the position corresponding to the 'at rest' position of the selector dial. At this point there are no further pulses, function relay 0-301 opens, and the stepping switch remains at its selected position until again dialed.

(6) In Modulator Type 50H1, the contacts of stepping relay K-301 are connected as described in paragraph 5, performing the functions required to operate a transmitter installation consisting of Wilcox series 96 units.

Section III. DIRECT MULTIPLE LINE AND SWITCH CONTROL

7. General

Wilcox Modulator Type 50H1 is equipped with a large terminal board in which all control functions are terminated. Direct multiple line and switch control may be accomplished by running a control cable between the remotely located operator's position and the transmitter. A complete transmitter installation generally consists

of one or more R-F units of the Wilcox 96 series, one or more rectifiers of the Wilcox 36 series, and one or more Wilcox Modulators Type 50H1. The operator's equipment at the remote control point is described in paragraph 9.

8. Control Functions

The necessary control functions for a transmitter installation of the type described in paragraph 7 are three in number for each R-F channel. They are as follows:

a. Channel Selection. All Wilcox transmitters in the 96 series may be placed in a stand-by condition by application of a ground to the CHANNEL CONTROL terminal of the transmitter. This metallic ground (not earth) operates a relay in the transmitter which starts the blower, applies plate voltages to the low level R-F stages, and filament voltages to the driver and final amplifier stages. When connecting the equipment together at the transmitter, it is convenient to carry the channel control wires (one for each R-F channel) to the group of terminals 1 thru 10 of main terminal board TB-1 in Modulator 50H1. The remote control cable may then be connected to the same group of terminals, the terminals forming convenient tie points.

b. Carrier Control. Push-to-talk or keying operation of the transmitter is accomplished with a sensitive keying relay incorporated in each R-F channel. A metallic ground circuit between the remote control point and the transmitter is also required for carrier control. Terminals 11 thru 20 of Modulator terminal board TB-1 provide convenient tie points for both the control cable leads and the leads from the individual keying relays.

c. Modulator Control. Each R-F unit in Wilcox series 96 includes a carrier operated relay known as the UNDERLOAD RELAY. This relay is used to control the modulator. The fact that unmodulated channels are frequently included with modulated channels, together with the fact that it may be desirable to use the same channel for A1 and A3 emission, makes it mandatory that the underload connection in each R-F channel be carried separately to the remote control position. Modulator control is accomplished by connecting the underload relay in each R-F unit, through the wires in the control cable, to terminal 54 of Modulator terminal board TB-1 which connects with modulator control relay 0-206. This relay turns on the modulator after the transmitter carrier is up (R-F channel in operation). Terminals 21 thru 30 of terminal board TB-1 may be used as tie points for underload relay and cable connections.

d. In addition to the three control functions described in preceding paragraphs a, b and c, direct multiple lines and switches may be used to control the START-STOP relays in Wilcox Rectifier Type 36D1. The purpose and operation of these relays is described in Section II, paragraph 5-c (4).

e. No dialing unit is required in Modulator Type 50H1 when direct multiple line and switch control is used.

9. Operator's Equipment

a. The operator's equipment at the remote control position may consist of a group of telephone key type switches equal to the number of R-F channels in the transmitter installation, a telegraph key, a microphone equipped with push-to-talk switch, and a speech amplifier capable of supplying a signal level at the transmitter of not less than -15 db.

b. Each telephone key type switch should consist of three sets of normally open contacts; the first set for channel selection, the second set for carrier control, and the third set for modulator control. The third set of contacts is not required when the R-F channel is used exclusively for A1 emission. The first set of switch contacts are returned directly to the metallic system ground. The second set of switch contacts may be returned to ground through the push-to-talk switch or through the telegraph key in the case of CW channels. The third set of contacts are returned to Modulator terminal board TB-1, terminal 54.

c. Control wires for an all-telephone

installation will consist of the following: 3 single wires for each R-F channel, 1 pair of wires for audio, 1 ground wire, and 1 modulator control wire.

d. In the event it is desired to start and stop Rectifier Type 36D1 from the remote control point, a pair of single circuit momentary contact switches are required at the control position. In addition, three wires must be included in the cable between the control and transmitter positions.

Section IV. COMBINATION DIAL AND MULTIPLE LINE CONTROL

Figure No. 6. Dialing Unit Type 168C, rear view.

10. General

Combination dial and multiple line control is a relatively unique system based on the control circuitry incorporated in Wilcox Remote Control Console Type CS212. As the name implies, combination dial and multiple line control consists basically of a system in which dial control, as described in Section II, and multiple line control, described in Section III, are combined.

11. Control Functions

a. Wilcox Modulator Type 50H1 may be controlled from a remote point with Remote Control Console Type CS212 by using a Wilcox Type 168C Dialing Unit in the Modulator. This dialing unit, illustrated in figures 6, 7 and 8, is identical in external appearance to Dialing Unit Type 168AB2 described and illustrated in Section II. Dialing Unit Type 168C is mounted in the modulator cabinet in the position occupied by Dialing Unit Type 168AB2, figure 2.

b. A large number of Remote Control Consoles Type CS212 are in use in various parts of the world, controlling the functions of Wilcox 96C3, 36A, 36A4 and 50A3 transmitting installations. Wilcox Modulator Type 50H1 may be added to existing installations or may be used in conjunction with 96D Transmitters and 36D1 Rectifiers.

c. In the combination dial and multiple line control system utilizing Wilcox Type CS212 control equipment, transmitter carriers are controlled by a low level 1,000-cycle tone which actuates the electronic keyer in the transmitter. The keying tone is transmitted over an individual pair (telephone line) for each R-F channel and channel selection is accomplished by a simplex circuit over the same pair. Selection is made by the operator through the medium of a single-throw, double-pole key switch which connects the selected R-F channel to the tone oscillator incorporated in Remote Control Console CS212. Since the output center tap of the keying oscillator is grounded, the switching

operation closes the channel control relay in the selected R-F channel, placing the latter in a standby condition for CW operation. To modulate the R-F channel, the modulator is turned on by dialing which connects the modulator output to the selected R-F channel.

d. Due to the fact that transmitter selection and modulator control are independent functions, means must be provided for automatically releasing the modulator when the R-F channel is released. This is accomplished in Wilcox transmitters 96C3 and 96D by utilizing the normally closed contacts of the channel control relay as a release circuit for the dialing unit incorporated in the modulator. This function is facilitated by the Type 168C Dialing Unit used in Modulator 50H1 when a combination dial and multiple line control system is utilized. Strapping connections for this method of control are shown in schematic diagram, figure 11.

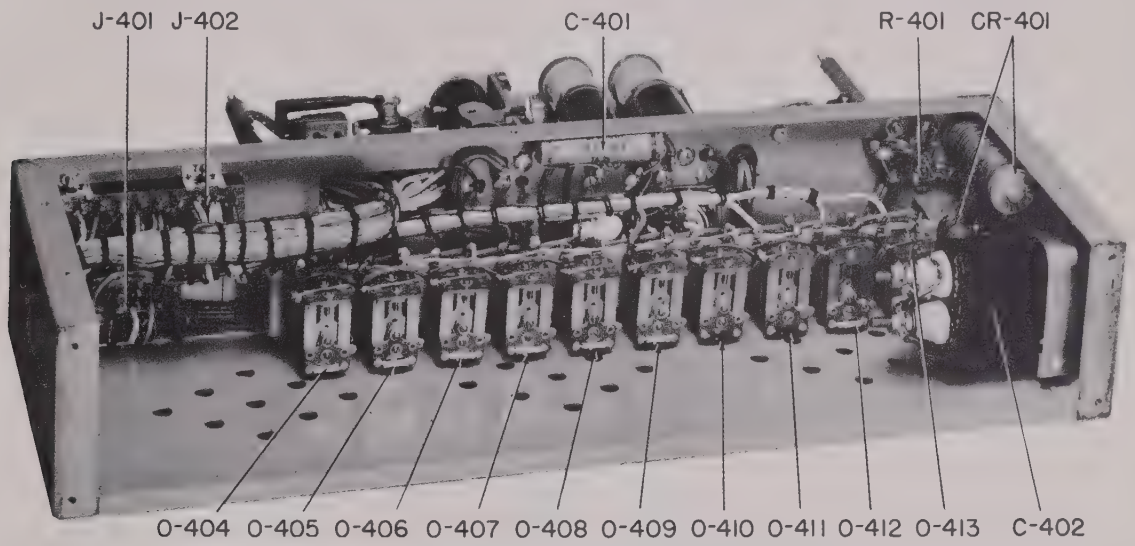


Figure No. 7. Dialing Unit Type 168C, interior view.

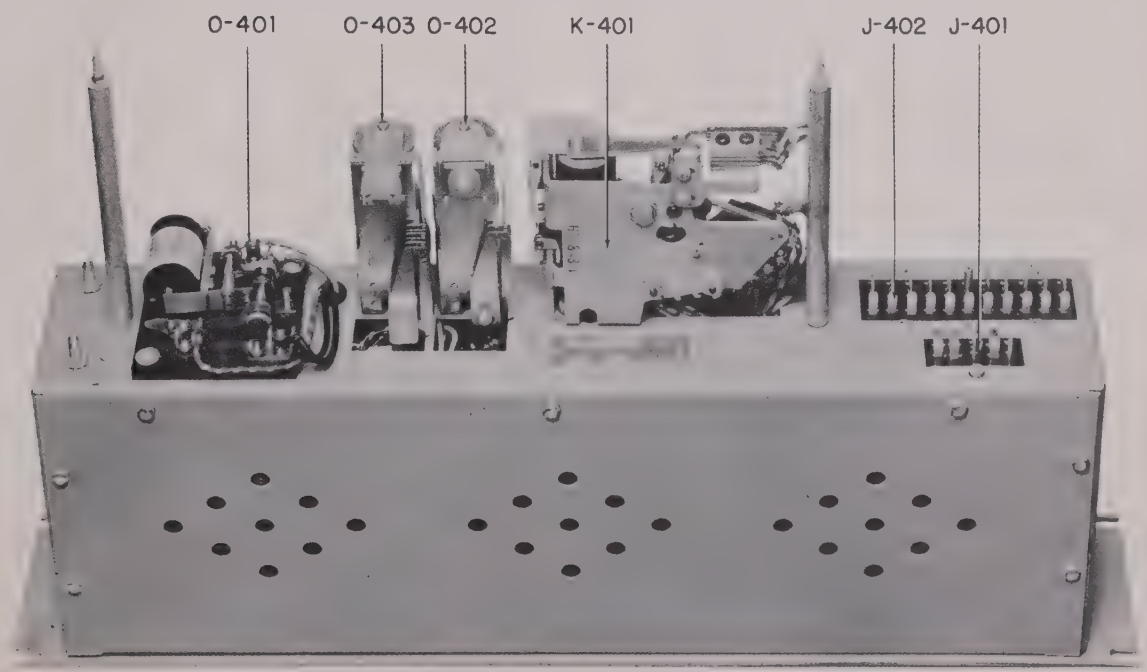


Figure No. 8. Dialing Unit Type 168C, dust cover removed.

Section V. INSTALLATION

12. General

a. Except for the omission of the Type 96151 Dialing and Auxiliary Relay Unit, and the high voltage filter components shown in figure 6, page 6, of the instruction book to which this supplement is attached, installation of Modulator Type 50H1 is as described in the instruction book. When Modulator 50H1 is purchased for dial control, Dialing Unit 168AB2 is supplied; when purchased for combination dial and multiple line control, Dialing Unit 168C is supplied. No dialing unit is required when the 50H1 Modulator is controlled by direct multiple lines and switches.

b. The Dialing Unit (either Type 168AB2 or Type 168C) is mounted in the modulator cabinet in the position shown in figure 2, with the multi-contact receptacles toward the cabinet front. Cable plugs P-2 and P-3 are so placed as to fit these receptacles and contain all necessary connections.

c. Modulation transformer T-1 is mounted at the right side of the bottom deck as illustrated in figure 10. Connections are also shown in this illustration. If a high voltage filter is used (paragraph 2-c) the filter components are mounted at the left of the modulation transformer and connected as shown in figure 10.

d. When Modulator Type 50H1 is supplied with other units, as a complete installation, instructions and wiring diagrams are supplied for interconnecting the particular installation.

Section VI. OPERATION

13. General

The amplifier and modulator circuits incorporated in Modulator Type 50H1 are the same as the circuits employed in the modulator described in the attached instruction book. With the exception of the control circuits described in this supplement, operation of the two types of modulators is identical.

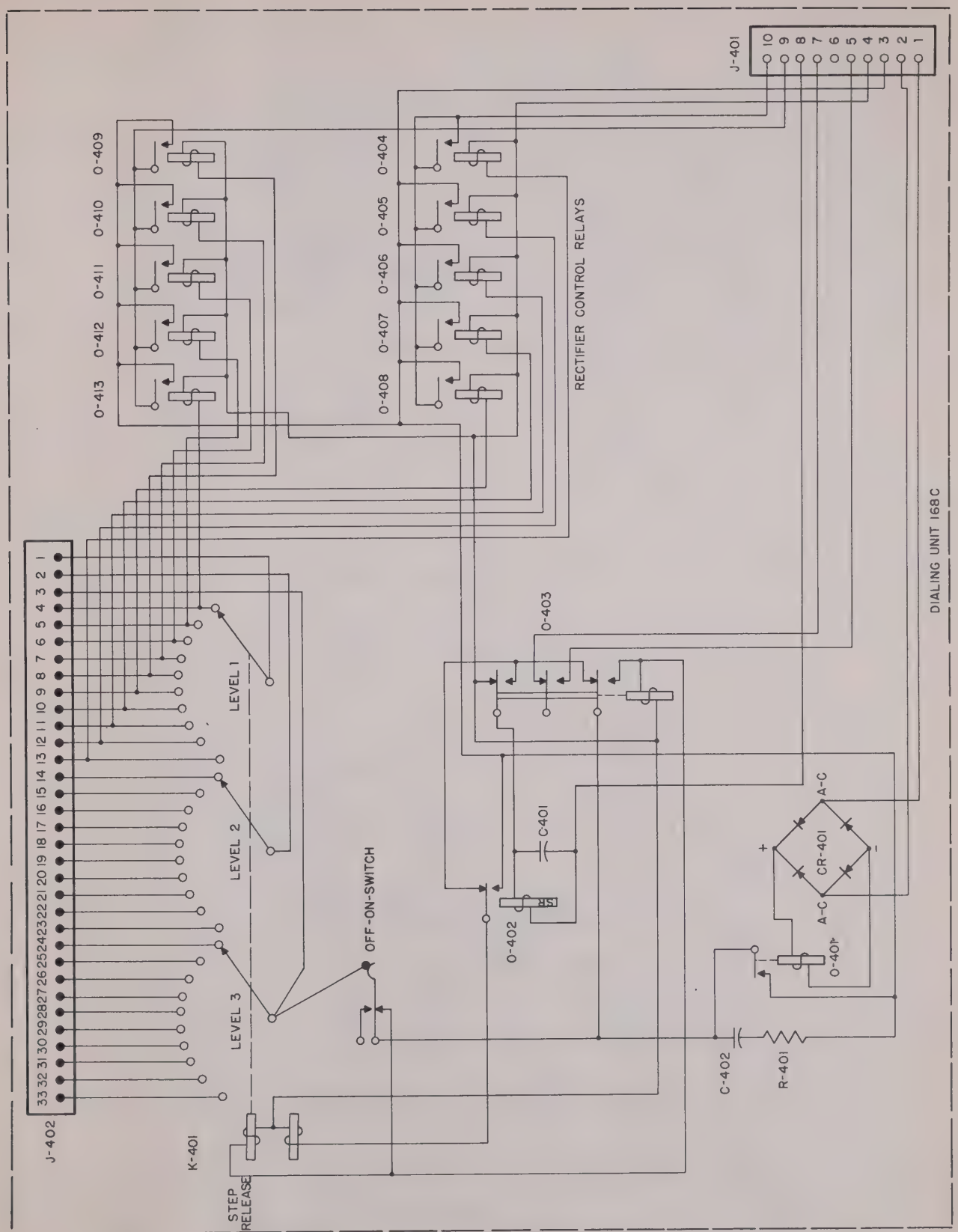
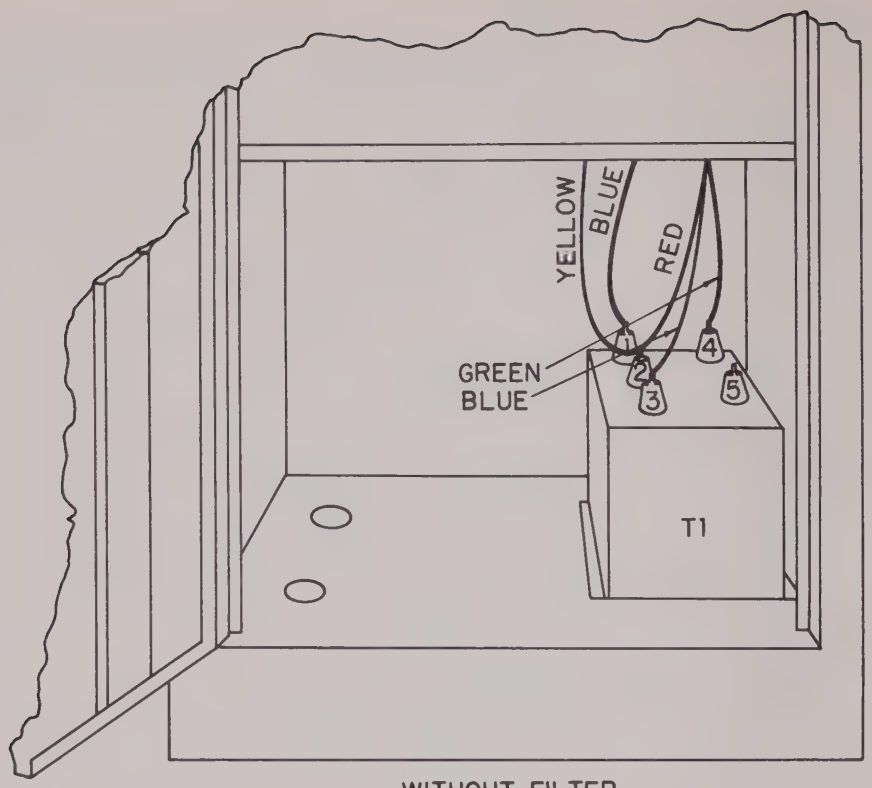
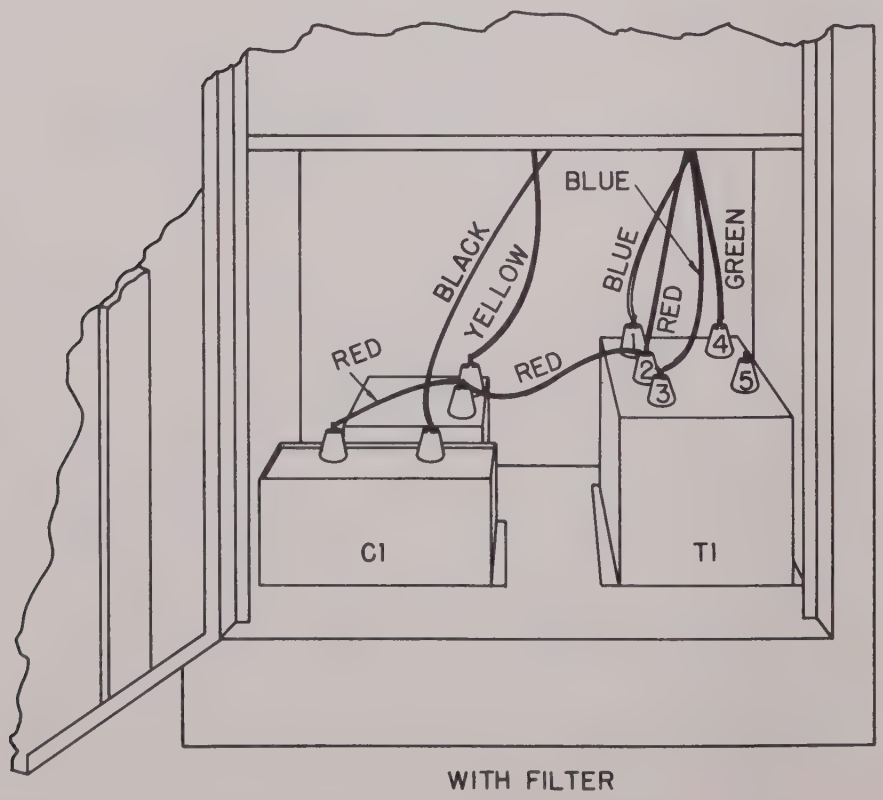


Figure No. 9. Dialing Unit Type 168C, schematic diagram.



WITHOUT FILTER



WITH FILTER

Figure No. 10. Modulator Type 50H1, bottom deck components.

APPENDIX I.

Identification Table of Parts,
Miscellaneous Parts not listed in 50H Instruction Book

Circuit Symbol	Description	Wilcox No.
F-211	FUSE, cartridge: 1-amp; 250-volt; cont oper at 110% load; opens in 25 sec at 200% load.	14022
T-202	TRANSFORMER, dialing: 2-15/16" x 2-1/2" x 2-1/16".	40008

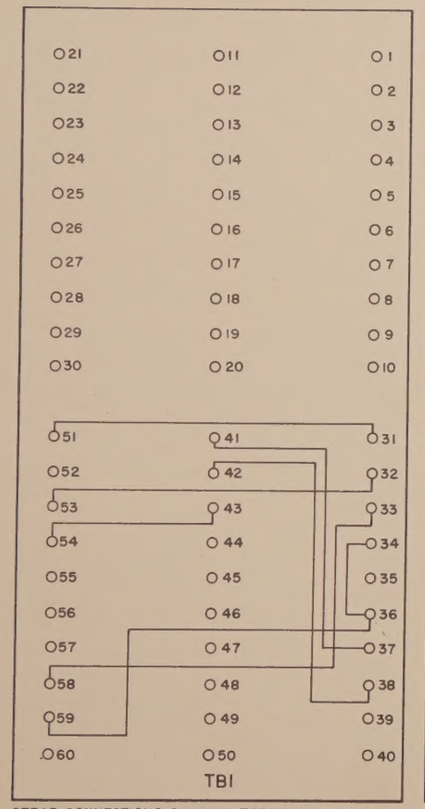
Identification Table of Parts,
Dialing Unit Type 168AB2

Circuit Symbol	Description	Wilcox No.
C-301	CAPACITOR, Fixed: paper; 1-mfd; 1000 vdcw; metal can; 2 post terminals at top; hermetically sealed; dimensions 2-1/8" x 1-3/4" x 1"; complete with mtg bracket.	19015
J-301	CONNECTOR, receptacle: 10 blade type male cont; polarized; straight type; 1-9/16" lg x 1-1/4" wd x 1-1/8" h.	28503
J-302	CONNECTOR, receptacle: 33 blade type male cont; polarized; straight type; 3-33/64" lg x 1-1/64" wd x 1-1/8" h.	28501
CR-301	RECTIFIER, metallic: selenium; full wave; input 110-volts a-c; output 60-volts, 100-ma d-c.	46004
K-301	RELAY, stepping: 3-level; 10-position; coil 12-volts d-c; 4-3/8" x 4" x 1-1/4".	10019
O-301	RELAY, armature: cont arrangement 2 form C; coil 200-ohms, 12-volts d-c; 4" x 2" x 1-1/4".	11512
O-302	RELAY, armature: cont arrangement 1 form C; coil 300-ohms, 12-volts d-c; 2" x 2-9/16" x 1-5/8" h.	11729
R-301	RESISTOR, fixed; composition; 100-ohm $\pm$ 10%, 1-watt.	52024

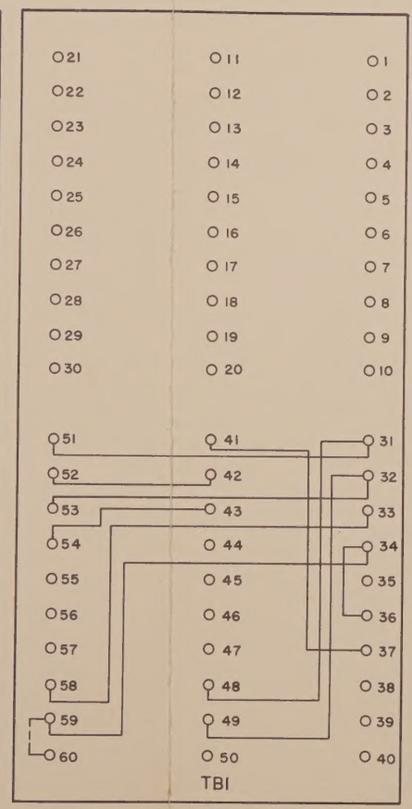
APPENDIX I. (Cont'd)

Identification Table of Parts,
Dialing Unit Type 168C

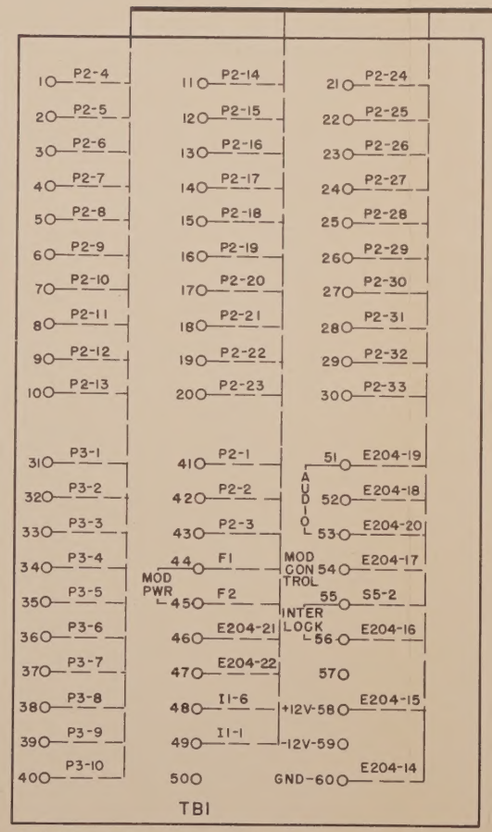
Circuit Symbol	Description	Wilcox No.
C-401	CAPACITOR, fixed: electrolytic; tubular; 25-mfd, 25 vdcw.	21011
C-402	CAPACITOR, fixed: paper; 1-mfd; 1000 vdcw; metal can; 2 post terminals at top; hermetically sealed; dimensions 2-1/8" x 1-3/4" x 1"; complete with mtg bracket.	19015
J-401	CONNECTOR, receptacle: 10 blade type male cont; polarized; straight type; 1-9/16" lg x 1-1/4" wd x 1-1/8" h.	28503
J-402	CONNECTOR, receptacle: 33 blade type male cont; polarized; straight type; 3-33/64" lg x 1-1/64" wd x 1-1/8" h.	28501
CR-401	RECTIFIER, metallic: selenium; full wave; input 110-volts a-c; output 60-volts, 100-ma d-c.	46004
K-401	RELAY, stepping: 3-level; 10-position; coil 12-volts d-c; 4-3/8" x 4" x 1-1/4".	10019
O-401	RELAY, armature: cont arrangement 1 form C; coil 300-ohms, 12-volts d-c; 2" x 2-9/16" x 1-5/8" h.	11729
O-402	RELAY, armature: cont arrangement 1 form C; coil 200-ohms, 12-volts d-c; 4" x 2" x 1-1/4".	11514
O-403	RELAY, armature: cont arrangement 3 form C; coil 200-ohms, 12-volts d-c; 4" x 2" x 1-1/4".	11519
O-404 thru O-413	RELAY, armature: cont arrangement 1 form C; coil 450-ohms, 12-volts d-c; 1-3/4" x 7/8" x 1-1/8".	11517
R-401	RESISTOR, fixed: composition; 100-ohm $\pm$ 10%, 1-watt.	52024



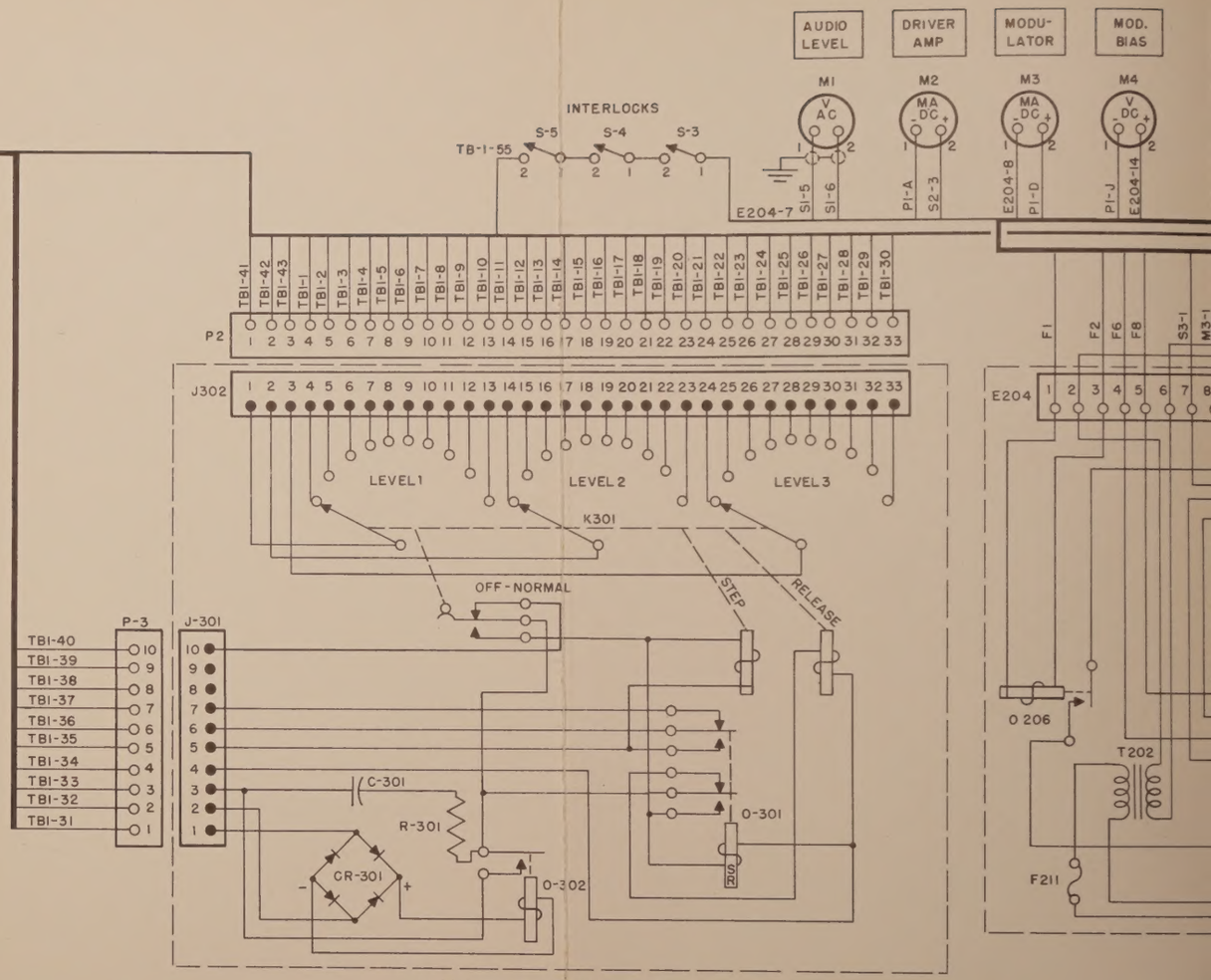
STRAP CONNECTIONS ON MAIN TERMINAL BOARD TBI—USE WHEN MODULATOR 50HI IS REMOTELY CONTROLLED WITH REMOTE CONTROL CONSOLE CS212 AND DIALING UNIT TYPE 168C.



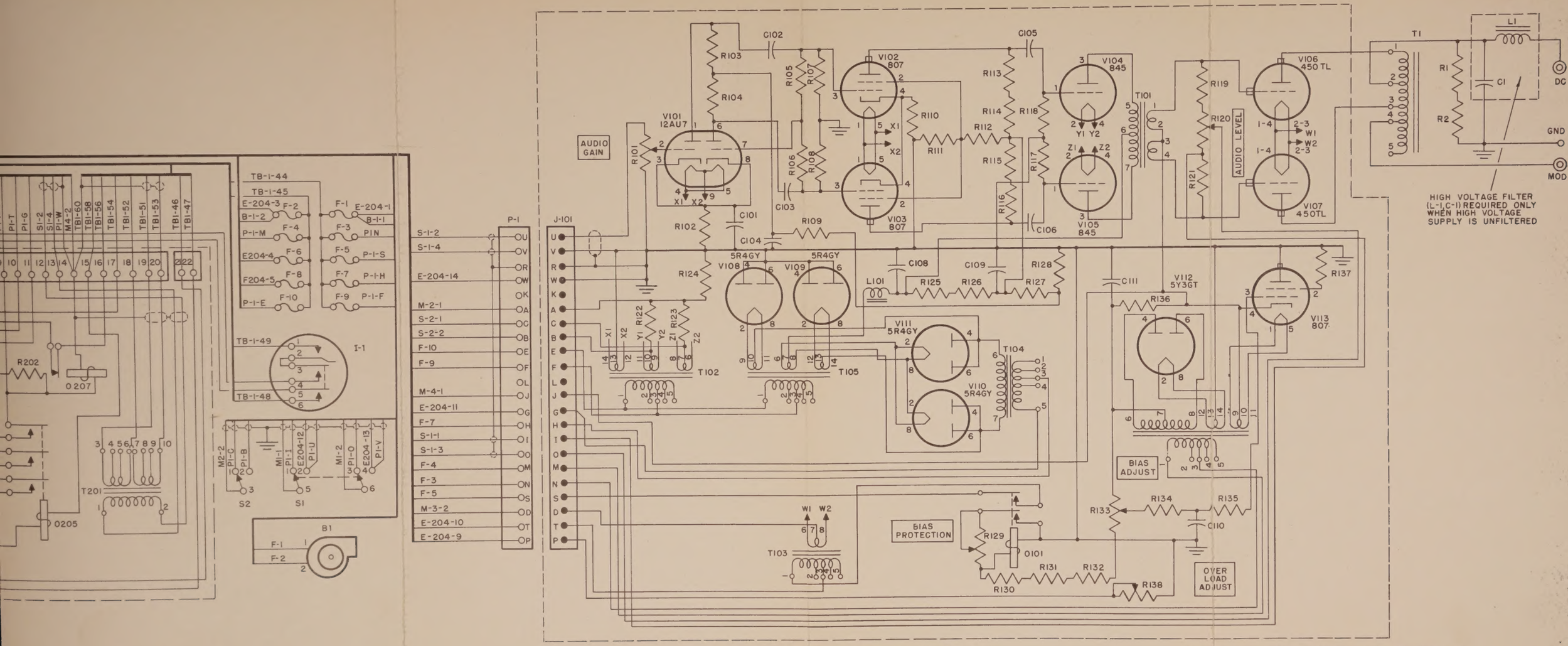
STRAP CONNECTIONS ON MAIN TERMINAL BOARD TBI—USE WHEN MODULATOR 50HI IS REMOTELY CONTROLLED WITH REMOTE DIAL AND DIALING UNIT TYPE 168AB2.



PERMANENT WIRING OF MAIN TERMINAL BOARD TBI IN MODULATOR 50HI.



DIALING UNIT TYPE 168AB2 (OPTIONAL EQUIPMENT).



SPEECH AMPLIFIER-MODULATOR TYPE 96152

Figure 11. Modulator 50H1, schematic diagram.